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BULLETIN NO. 81

DECEMBER, 1911

New Mexico College of Agriculture
and Mechanic Arts

AGRICULTURAL EXPERIMENT STATION

AGRICULTURAL COLLEGE, N. M.

The Grasses and Grass-Like Plants
of New Mexico

E. Q. WOOTON AND PAUL C. STANDLEY

RIO GRANDE REPUBLICAN

Las Cruces, N. M.

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New Mexico Agricultural Experiment Station.

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The bulletins of this Station will be mailed free to citizens of New Mexico and to others as far as the edition printed will allow, on application to the director.

A WORD OF EXPLANATION

The Intention of this Bulletin is primarily to answer the questions of the man who wants to know about the native grasses and grass-like plants of New Mexico. There are three kinds of individuals interested in this. 1. The man who is trying to make a living on a "dry farm" wants information about pasture grasses. We have attempted to recommend the grasses he finds already growing on his land and to assist him in recognizing the best ones. 2. The stockman who wants to know more about the grasses on his range. There is bound to be an increasing number of stockmen who will want to know about these grasses as the business becomes more systematized and greater attention is given to the proper care of the ranges. There is as much difference between grasses as feeds as between any other kinds of plants and the enterprising stockman will wish to encourage the good ones and exterminate the bad ones on his range, but to do this he must know most of them. 3. The occasional student of plants, in school and out of it, who wishes to know more about those of this State. There is already some call for this information and there will be much more of it as more people come into the State.

The Plan of the Bulletin is to present first, in as untechnical language as possible, a discussion of the economic importance of the grasses and grass-like plants of the State; and to follow that with a set of "keys" for the determination of species and a list of the species, giving the geographical and zonal distribution of each as completely as it is now known. For the sake of completeness all species are included but the technical part of the bulletin is put in smaller type and the style of the type varied in order to make the whole as usable as possible and indicate the relative economic or scientific importance of the parts at a glance.

The maps are designed to give the best information now obtainable on the subjects mapped. The map showing grass societies is a correction of that published in Bulletin Number 66 of this Station, and is in the opinion of the authors as accurate as such a map can be made on so small a scale. It must be understood that all the maps are tentative and simply represent progress to the present time.

The relief map is a decided improvement over that published in Bulletin Number 66 and is included to show the more prominent relief features of the State because they are more important as regulating the climatic conditions of the State as a whole than any one other factor. Of course this map has numerous inaccuracies which will no doubt ultimately be corrected. It was prepared from the best data obtainable under the direction of one of us.

The zone map is a copy of one prepared in the Bureau of Biological Survey, Washington, D. C., by Mr. Vernon Bailey, who, with his assistants, has been working at this subject for a number of years: the result speaks for itself. Our copy is but a poor imitation of their finely colored map, but will no doubt serve all that is here required.

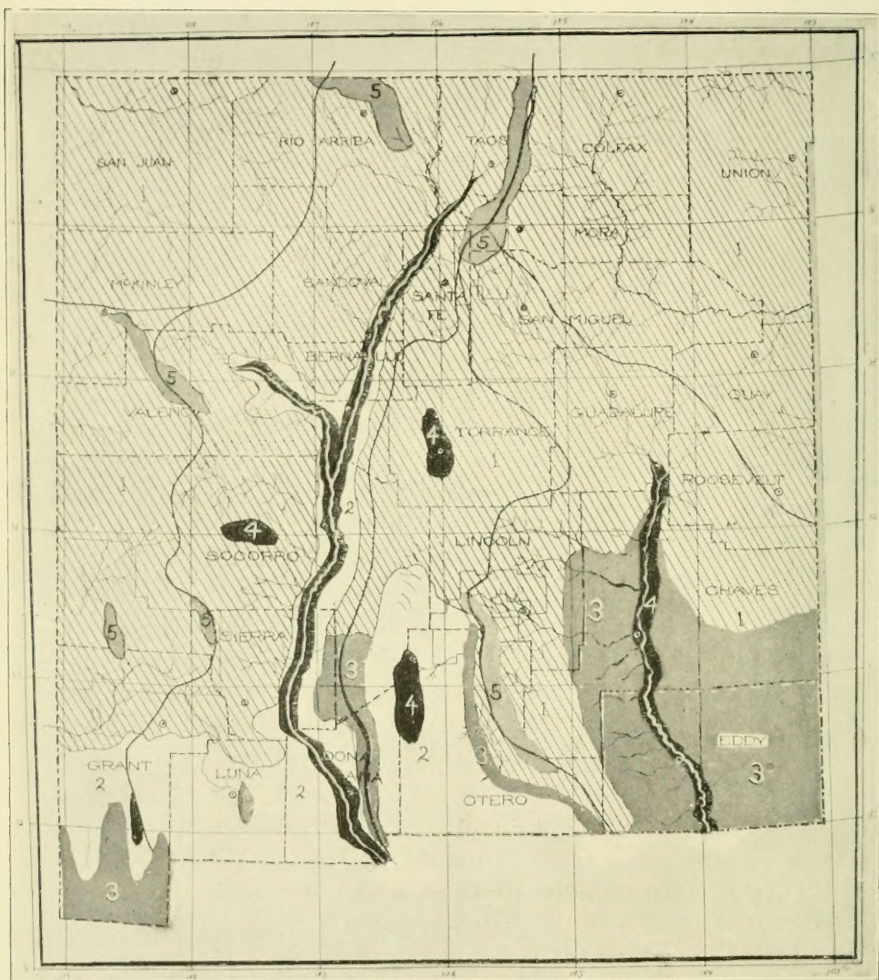
The figures are copies of lithographs made in what was the division of Agrostology, United States Department of Agriculture, either by or under the direction of Dr. F. Lamson-Scribner and are the best that have so far been produced.

A paragraph on "How to use the Keys" precedes the first key, and an explanation of the various technical terms used in describing a grass with an illustrative diagram of a grass is also given. Descriptions of the characteristics of the grasses (GRAMINEAE) the sedges (CYPERACEAE) and the rushes (JUNCACEAE) precede the keys to these families in the order named.



TENTATIVE RELIEF MAP
OF
NEW MEXICO

Prepared under the direction of
E. O. Wootton.



AN OUTLINE MAP OF NEW MEXICO SHOWING THE DISTRIBUTION OF THE PRINCIPAL GRASS SOCIETIES.

1. The Blue Grama Society. The society in which Blue Grama is the dominant species. It covers the higher plains, the forest, and woodland areas.
2. The Black Grama Society. This is the society which occupies the lower plains of the Territory. The principal grasses are Black Grama, Tobosa, and the Needle Grasses.
3. This society is intermediate between 1 and 2. The characteristic grass is Hairy Grama, which replaces much of the Blue Grama and all of the Black Grama.
4. The Salt Grass Society. Mainly composed of Bunch Grass and Salt Grass, with sedges and rushes in wet situations.
5. The Arizona Fescue Society. The dominant grass is Arizona Fescue. The society usually occurs high in the mountains on open slopes and "burns."

INTRODUCTION

One of the important natural assets of New Mexico is the crop of forage which grows upon its unoccupied land or open range. There is little doubt that improved methods of cultivation and the discovery of water supplies not now known to exist will ultimately increase the area of patented and farmed lands in the State; but until that occurs the open range will continue to bear a crop of forage the harvesting of which by means of animals gives rise to a very important industry. By far the larger number of wild plants that grow on the open range form a part of that forage crop, be they low herbaceous "weeds," grasses, sedges, or the smaller shrubs. But considerably the most important groups are the grasses, and the grass-like sedges and rushes which most people think of as grasses.

As has been indicated in a former bulletin* of this Station, the most important species of forage grasses are rather few in number and are associated together in pretty well marked societies adapted to particular climatic conditions. But there is a large number of grasses and grass-like plants growing on the open range, and the Station botanist is being called upon continually for information concerning them. The people who are occupying the land are beginning to be more anxious to know about the relative merits of the different kinds and it becomes necessary to have some names to call them by and some means of knowing that we are all talking about the same thing when we use a given name—a condition that does not now exist. Unfortunately a difficulty arises at this point. Many of the grasses have no common names of any kind. Some of them have two or three for the same grass, the different names being used in

* Bulletin No. 66, New Mexico Agricultural Experiment Station.
The Range Problem in New Mexico.

different localities. Not infrequently the same common name has been used for two entirely different grasses at different places. The name grama grass, the grama probably of Spanish origin, is much misused. Every one has heard it and has heard of white grama and black grama and possibly blue grama, and the average individual, assuming grama to be everywhere over the region, picks out a grass which is "white" or "black" or "blue" as he sees it and calls it the corresponding grama. The process (and others equally logical) results in a very mixed nomenclature which only confuses.

A botanist at once would suggest that the Latin names of the plants be used for the sake of accuracy, but the average man is unable to think of a grass by a Latin name because his attention is drawn away from the grass by the linguistic difficulty of the name. Herein lies the difficulty and a problem which is not solved in the following bulletin because the authors can neither make common names for all the plants nor so present the Latin ones to their readers that they will not be more or less confusing at least to some who really do want to know about the grasses.

The authors, attempting to "straddle" the difficulty, have presented in untechnical language some notes on the more important species under the common names whenever there are any, and have tried to straighten out any confusion in the use of these common names. Whenever an important grass has no common name we have used the Latin one, referring also to its relationship. In order to have something definite to correlate the names with, a set of figures that are typical of the different genera and represent some of the more important species is included. For the sake of those who are interested enough to investigate the technical side of the subject all the species are listed with ordinary "keys" for the determination of tribes, genera and species. In these "keys" it is of course necessary to use technical descriptive terms. Definitions of these terms can

be found in the glossary of any botanical text or in a good dictionary. In distinguishing the species it is sometimes necessary to use measurements, and for this purpose (as well as for giving ranges of altitude) the English units of feet and inches are used. But for very small units millimeters (mm.) are used, because they are more convenient. There is no convenient small measure in the English system, it being necessary to refer to everything in some fraction of an inch. To use the English measures therefore involves the continual use of fractions, which is very undesirable. Consistency would seem to demand the uniform use of one system, but the authors prefer to be practical before being scientifically consistent; hence they use millimeters (1-25 of an inch) for all small measurements (the only measurement necessary for the average man to learn) and inches and feet for all measurements over an inch long or thereabouts.

The common names, as far as they are known to the authors, are given with their proper Latin equivalents in the tabulated list of species, where the distribution in area and altitude (zonal) is nearly always given. By reference to the accompanying zone map a good idea of the distribution of a species may be obtained. The data here given refer only to New Mexico unless otherwise stated.



MESQUITE GRASS. (*Muhlenbergia Porteri*.)

(Reprinted from *The Grazing Ranges of Arizona*, by J. J. Thornber;
Bull. 65, Arizona Agr. Exp. Station.)



Life Zone Map of New Mexico from a Map Furnished by the Bureau of Biological Survey,
U. S. D. A., Washington, D. C.

LIFE ZONES

No one who has traveled long distances over the earth's surface has failed to note the changes in the plant life which occur as the result of change of latitude. And he who has climbed high mountains has appreciated more or less the changes occurring in the vegetation as he has gone towards the top. If he has thought of the reasons for such changes and obtained a definite idea of the conditions as they exist on any high mountain, he has probably grasped the idea that the changes are due to that very poorly defined summation of factors which we call climate, a variable thing which is to some extent governed by latitude and altitude. If his observations have been fairly accurate and extensive, he has seen that the vegetation is approximately in irregular belts surrounding the mountain or spread over the flat country in broad uneven bands. These bands or belts show close relationship to the latitude and altitude and each is more or less characterized by certain groups or societies of plants and animals.

As a means of understanding the distribution of plant and animal life and as a basis for the study of the factors which govern this distribution, considerable work has been done in mapping these larger life areas or zones and much has been written on the subject.

On account of the large variations in altitude (and to a much less degree in latitude) New Mexico is not like the flat states of the prairie, valley, or coastal plains regions farther east, but has areas within its borders that correspond in climatic variation with those found in the flat country ranging from the subtropical to the arctic areas. These life zones are of the utmost economic importance in the State, since they mark in a visible form the areas having certain fairly definite climatic conditions. And these climatic con-

ditions determine the kinds and quantities of cultivated plants that will grow in such areas, and thus regulate to a marked degree the activities of men in the region.

Since the grazing industry is almost wholly dependent, as yet, on the natural distribution of the plants of the State, and since man can regulate this distribution little or none by any artificial means, these natural life zones are of particular interest and importance to stockmen.

A large amount of work has been done by the investigators of the Bureau of Biological Survey, United States Department of Agriculture, on the Life Zones of New Mexico and they have prepared a map outlining these zones, which will be published in a short time. Through the kindness of the chief of this Bureau, Dr. H. W. Henshaw, we are permitted to print a reduced and rough copy of this map which will give some general idea of the areas included in each zone in the State. We use the names for the zones now generally used in American publications on the subject, and append lists of some of the most characteristic plants of each zone. In all comparisons with zones of the humid region the reader must remember that New Mexico is all above 3500 feet altitude and that the air is correspondingly thin, as the result of altitude, and is also very dry nearly all the time. These two conditions materially influence the climate by their effect upon radiation, and in consequence the daily variation of temperature is always and everywhere very large. This makes the mean temperature the average of a high maximum and a low minimum, and since the extreme temperatures are of much more importance in governing plant distribution than the mean, the arid zone equivalents do not exactly correspond with those of similar name in the humid regions. There are a number of other factors entering into the problem which need not be mentioned here.

Commencing at the southern end of the State in the lowest valleys and following northward and upward, we

have the following named zones in New Mexico, with lists of some of their most characteristic plants, by which they may be recognized.

1. Lower Sonoran Zone. This covers the lower plains and mesas and the larger river valleys of the southern third of the State. Characteristic woody plants are the Creosote Bush (*Covillea glutinosa*) (often mistakenly called Greasewood), the Spanish Bayonet or Dagger (*Yucca macrocarpa*), *Zizyphus lycioides*, *Condalia spathulata*, Tornillo or Screw Bean (*Strombocarpa pubescens*), *Acacia constricta*, *Acacia greggii*, Desert Willow (*Chilopsis linearis*) and Valley Cottonwood (*Populus trichocarpa*). On the mesas Black Grama (*Bouteloua eriopoda*), Tobosa Grass (*Hilaria mutica*), False Needlegrass (*Scleropogon brevifolius*), Mesquite Grass (*Muhlenbergia porteri*) and several of the true needlegrasses (*Aristida* spp.) are characteristic, while in the valleys Salt-grass (*Distichlis spicata*) and Bunch grass (*Sporobolus airoides*) are common, especially in alkaline soils. A number of species of Cacti are also common. This zone is dry all the time and hot in the summer time. The average precipitation is 8 or 9 inches and the maximum summer temperature is from 100° to 106° F.

2. Upper Sonoran Zone. This zone covers the plains and wooded foothills of the mountains and follows back up the watercourses in the mountains into the timbered area. Its separation from the zone below is not well marked. The characteristic woody plants are the Pinyon (*Pinus edulis*), the Alligator-bark Juniper (*Sabina pachyphloea*), the Cedars or Sabinas (*Sabina monosperma* and *S. utahensis*), several of the evergreen Oaks (*Quercus arizonica*, *Q. grisea*, *Q. emoryi*, *Q. hypoleuca*), Mountain Mahogany (*Cercocarpus paucidentatus*), Algerita (*Odostemon haematocarpa*), Wild Grape (*Vitis arizonica*), Choke Cherry (*Padus* spp.), the Sycamore (*Platanus wrightii*), several Willows (*Salix* spp.), the Alder (*Alnus oblongifolia*), the Hackberry (*Celtis*

reticulata) and Mulberry (*Morus microphylla*) besides many smaller and less conspicuous plants. The trees and shrubs are mostly restricted to the foothills and arroyos while the higher plains are usually thickly covered with grass, the most characteristic species of which are Blue Grama (*Bouteloua oligostachya*), Galleta Grass (*Hilaria jamesii*), Buffalo Grass (*Bulbilia dactyloides*), Porcupine Grass (*Stipa comata*) and *Muhlenbergia gracillima* besides many other species of less importance. Sagebrush (*Atriplex* spp.) is also found on these plains in the northern part of the State. The annual precipitation in this zone is probably from 12 to 15 inches as an average, and the maximum temperature approximately 90° to 95° F.

3. Transition Zone. This zone is easily marked at its lower limit by the lower limit of the Yellow Pine (called Bull Pine in the mountain regions farther north and west), (*Pinus brachyptera*). Its upper limit is not so well marked, since it gradually shades into the next zone above. The zone lies wholly in the mountains and includes the lower 1000 feet or so of the area timbered with large forest trees. Characteristic woody plants are the Yellow Pine (*Pinus brachyptera*), the Mountain Cottonwood (*Populus angustifolia*), several Willows (*Salix bebbiana*, *S. monticola*, *S. irrorata*, *S. lasiandra*), the Rocky Mountain Cedar (*Sabina Scopulorum*), *Alnus tenuifolia*, several of the deciduous leaved Oaks (*Quercus utahensis*, *Q. neomexicana*, *Q. submollis*, *Q. venustula*, *Q. leptophylla* and *Q. gunnisonii*), the Wild Hop Vine (*Humulus lupulus neomexicanus*), Buffalo Berry (*Lepargyrea canadensis*, Virginia Creeper (*Psedera vitacea*), Buckthorn (*Rhamnus* spp.), Hawthorn (*Crataegus* spp.), Wild Gooseberries and Currants, and many others. The grasses and herbaceous plants are very numerous—the commonest of the former being Colorado Bluestem (*Agropyron smithii*), the Wheat Grasses (*Agropyron* spp.), some of the Rye Grasses

(*Elymus* spp.) and June Grass (*Koeleria cristata*). The precipitation in this zone is probably between 15 and 20 inches annually and the maximum temperature rarely over 90° F., usually less than that.

4. Canadian Zone. This zone is hard to separate from the Transition Zone, and the line of demarcation from the zone above it is equally indefinite in this State. The commonest trees are the Bristle-cone Pine (*Pinus aristata*), Limber Pine or Western White Pine (*Pinus flexilis*), the Douglas Spruce or Fir (*Pseudotsuga mucronata*), the Balsam (*Abies concolor*), the Quaking Aspen (*Populus tremuloides*), and one or two willows of the Transition Zone (*Salix* spp.) The most characteristic grass of this zone is the Arizona Fescue (*Festuca arizonica*), but this grass goes higher and lower occasionally. Several species of sedges and rushes occur freely in the zone.

5. Hudsonian Zone. This is a narrow poorly defined zone just below timber line. Its characteristic trees and shrubs are the Siberian Juniper (*Juniperus sibirica*), Engelmann's Fir (*Picea engelmanni*), Parry's Fir (*Picea parryana*), two or three species of Currants (*Ribes montigenum*, *R. coloradense*), and a low Willow (*Salix glaucops*). A number of species of sedges (*Carex* spp.) and rushes (*Juncus* spp.) are common, while the grasses are all low, the genus *Festuca* being most common.

The temperature in the last two zones is never very high, probably rarely over 80° F., and the season is short: the precipitation will average between 20 and 25 inches annually and much of it comes as snows in the winter time.

6. Arctic—Alpine Zone. This is the small area of high mountain peaks above timber line. The vegetation consists of a few low shrubs, occasional stunted trees of the zone below, grasses and herbs. Several species of Willows (*Salix* spp.) from a few inches to 2 or 3 feet high, the Arctic

Poppy (*Papaver coloradense*), various Saxifrages and Gentians, with several species of *Carex*, *Juncus* and *Juncooides*. There are no accurate data as to the temperatures or precipitations of the high mountain tops which constitute this zone in New Mexico, but the maximum temperature is never high, it probably freezes most of the nights in the year at such elevations and such peaks are certainly snow covered a large part of the time.

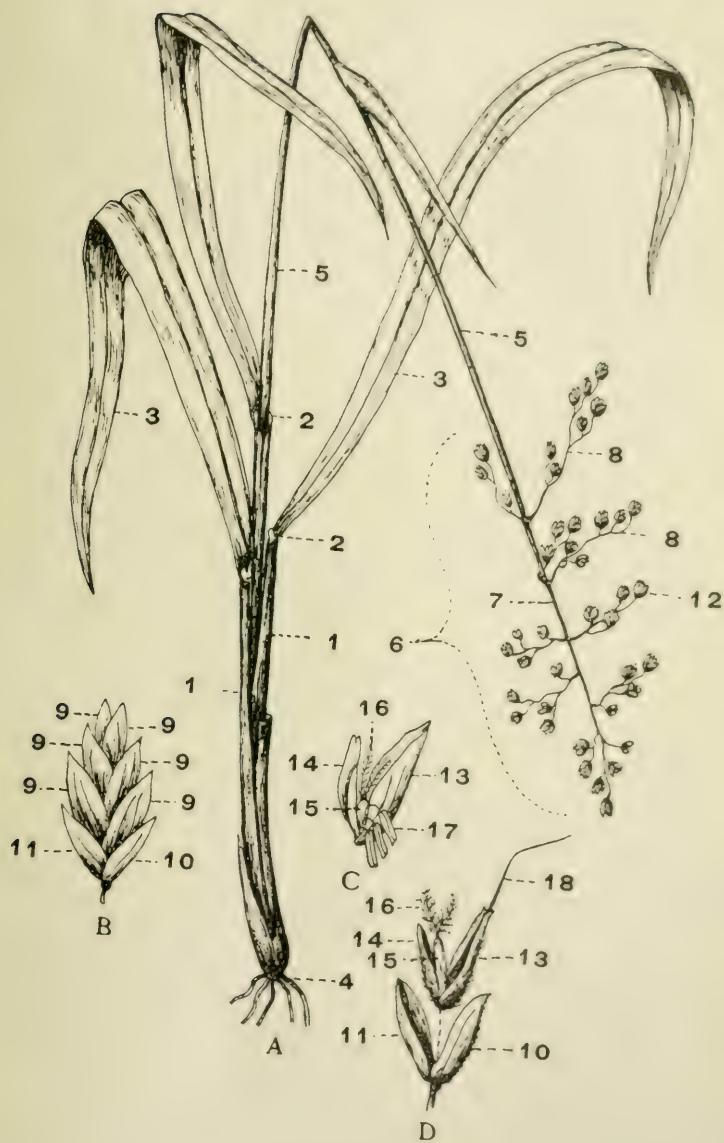


DIAGRAM OF A GRASS. A.—A single plant about life size. B.—A spikelet of several flowers, enlarged. C.—A single floret enlarged. D.—Another spikelet having but one flower, dissected.

I.—Sheaths. 2.—Ligules. 3.—Leaf blades. 4.—Root. 5.—Stem or culm. 6.—The panicle. 7.—The rachis. 8.—Branches of the panicle. 12.—A spikelet. 10.—First empty glume. 11.—Second empty glume. 9.—Separate florets in a spikelet. 13.—First flowering glume (Lemma). 14.—Second flowering glume (Palea or Palet). 15.—Ovary which becomes the seed. 16.—Stigma. 17.—Stamens. 18.—An awn.

THE GRASSES

For the sake of those who wish to use the keys and attempt to determine the species of grasses here listed for New Mexico, the following description of the grasses is inserted, and, if used with the diagram and its explanation, even a novice may hope to determine most of the species of the State.

There are many kinds of grasses (about 3500 species in all) and they are scattered almost all over the earth. New Mexico has representatives of 9 tribes and 72 genera in the 235 and more species here listed. They vary in size from small annuals an inch or two high to great reeds 10 to 15 feet high within our range, while in other localities the giant bamboos are almost tree-like in proportions and live many years. Most grasses are low plants, from a few inches to 3 or 4 feet tall, sometimes growing as single stems though mostly in clumps or bunches of several stems together. Many of them spread by means of underground stems called rootstocks or rhizomes or by prostrate rooting stems called runners. Some of the "bunch grasses" spread by growing only on the outside of the "bunch" and dying off in the middle. All the sod forming grasses have some method of spreading either slowly or rapidly.

The stems of grasses (called culms to distinguish them from the stems of other plants) are mostly hollow (fistulous) and have thickened solid places at approximately equal distances (nodes) from which the leaves begin to grow. The base of each leaf is a flat portion folded around the culm for some distance, often more than the distance between the nodes (internodes). This sheathing portion is called the sheath. At the top of the sheath there is usually a small thin, colorless projection or ring-like growth seeming to be a mere continuation of the sheath beyond the base of the leaf blade. This

projection (ligule) is sometimes hard, usually not very conspicuous, sometimes reduced to a ring of hairs. The part of the leaf beyond the ligule is known as the leaf blade and it is sometimes broad as in corn or sorghum, or it may be very narrow and rolled in, or any condition between these extremes. The roots of grasses are always fibrous, i. e. consisting of several branching roots all of about the same size, without a taproot.

Terminating the culm is the inflorescence or flower cluster, always referred to as a panicle, though sometimes the branches are so short as to make the panicle a spike. Terminating each branch or subbranch of the panicle is a small cluster of flowers called a spikelet whether it contains one or more flowers or florets. That part of the culm which forms the central stem of the panicle is called the rachis.

The flowers of grasses are different from most flowers in that a true calyx and true corolla are not present. Instead each flower is enclosed in two leaf-like scales called floral glumes; the outer one (the first floral glume) is sometimes called the lemma, the second is called the palea or palet. Enclosing each spikelet at its base is a pair of leaf-like scales known as the empty glumes, the lowermost one being the first empty glume, the other the second. The glumes both floral and empty may assume almost any shape or any texture from thin membranaceous to hard and almost woody; they may be smooth or hairy, rough or glossy, they may be tipped with short or long "beards" called awns; they may have prominent or indistinct or no veins (nerves), they may be clear and colorless, green, yellow, brown, or black; they may be free from the grain and fall away as chaff or they may enclose it and form a part of the "seed."

Inside the floral glumes are the essential organs of the flower; the pistil with its basal ovary, which ultimately becomes the grain, tipped by the more or less feathery (plumose) stigmas; the stamens (1 to 6, usually 3 in number) which are but little elongated sacks (anthers) filled with the

fertilizing dust (pollen) and suspended by slender threads (filaments). The flowers may have stamens alone (staminate flowers) or pistils (pistillate flowers) or both (perfect or hermaphrodite flowers), or the floral glumes may be empty by the atrophy of the parts, when the flowers are neutral. When the flowers have but one kind of organs present they are said to be unisexual. When the unisexual flowers of both kinds are on the same plant the plant is monoecious: if the flowers of the two sexes are on different plants the species is dioecious. If both perfect and unisexual flowers are on the same plant it is said to be polygamous.

Inside the floret at the base are 1 to 3, usually 2, thin transparent scales called lodicules which can only be seen with a lens. The small stem to which the florets are attached in the spikelets is called rachilla. The fruit is called a caryopsis or grain.

The diagram shows a single culm with its attendant sheaths, leaves, ligules and panicle in the figure A. Figure B. represents a spikelet having several flowers. Figure C. shows a single floret from B still farther magnified with its parts numbered. Figure D represents a single-flowered spikelet dissected to show the parts which are numbered and explained.

It should be remembered that the keys are largely artificial and that any slight difference which is easily seen is usually taken to separate species or genera, because there are so very many different and easily recognizable species that it is almost impossible to separate by description. Insignificant characters are used in much the same way that one would describe a man as having lost a particular finger or having a special birthmark. It serves not to describe but to distinguish him from all others but is of little importance otherwise.

HOW TO USE THE KEYS

To learn the specific name of any grass listed in this bulletin—with a specimen of the mature grass, having the flowering panicle, in hand—turn

1. To the "Key of the Tribes" of grasses just after the general description of the "Gramineae," The Grass Family. There you will find sets of descriptions of various characters arranged in pairs of co-ordinate rank, followed by other co-ordinate pairs but subordinate to the first pair, each in an increasing order of subordination. Under the first pair of coordinates will appear all its subordinates of all degrees of subordination, and the second pair of coordinates may be recognized as beginning the same distance from the margin as the first. Each of these sets of characteristics is in the nature of a question which the student must ask himself, and the answer is always yes to one question and no to the other of the coordinate pair; but which is "yes" must be decided from an examination of the specimen. Thus in the first key either the "Spikelets fall from the pedicels entire," etc., or the "Spikelets have the rachillae jointed above the empty glumes" and these glumes remain after the "seeds" have fallen. Suppose the first of these two conditions is correct for the grass in hand; then the grass must belong to Tribes I, II, III or V. Then one must decide the next question in order: are the "Flowering glumes hyaline" (i. e. thin and transparent) or are those of the perfect flower "similar in texture to the empty glumes or thicker," etc. Suppose the answer to the first question is yes, the grass must belong to Tribes I or V. Then are the "Spikelets in pairs" or "not in pairs"? If the former, the grass is in Tribe I, Andropogoneae. Then turn

2. To the Key of the tribe just found, and use it in the same way until the name of the genus is found, when it is time to turn
3. To the key of the genus, if there are more than one species of that genus in the State, and find the specific name in the same way. The name of the grass is the genus (generic) name and the species (specific) name combined as a man's name is, except reversed—as Smith John instead of John Smith. Following the key of the species will be found a list of the species of that genus with the full name of each followed by (1) an abbreviation of the name of the man or men who named it; (2) the common name if it has any; and (3) a statement of its distribution in the State. If this latter statement does not agree with the facts concerning the grass in hand the determination is probably incorrect or a grass has been found that is not included in the list. Special care has been taken to include all species of which collections have been made, but a few may have been omitted and there are doubtless some species growing in the state that have not been collected, though they are probably very rare. After determining the species, the student should turn
4. To the general discussion of that genus which precedes the key to the tribe in which it belongs. If it is a common grass he will probably find some confirmatory evidence of the correctness of his determination and what data are to be had on the economic importance of that grass and will know the most of what is known about it. He is warned not to allow the common name to have much weight in settling questions. For technical descriptions of the species the student is referred to the various Manuals of botany, such Coulter's Manual of Western Texas, Small's Flora of the Southeastern States, Coulter and Nelson's New Manual of the Rocky Mountains, (Rydberg's Flora of Colorado only has keys

and distribution in Colorado but is very helpful), the various publications of the United States Department of Agriculture on Agrostology of which American Grasses I, II and III and the monographs of different genera are about the last word on the subjects covered. Coulter's Flora and the United States Department of Agriculture publications may be obtained from the Division of Publications, Washington, D. C., at a nominal cost. Rydberg's Flora is Bulletin No. 100 of the Colorado Experiment Station. Coulter and Nelson's Manual is published by the American Book Company and Small's Flora may be had from the author, Dr. J. K. Small, New York Botanical Gardens, Bronx Park, New York City.

The Grasses and Grass-Like Plants of New Mexico

KEY TO THE FAMILIES HERE TREATED

- Perianth rudimentary or degenerate, its members being mere bristles or scales; flowers in the axils of dry chaffy scales or glumes.
Leaves 2-ranked; sheaths with the margins not united; stems mostly hollow and jointed; fruit a grain. Family I. GRAMINEAE.
- Leaves 3-ranked; sheaths with margins united; stems solid, mostly not jointed; fruit an achene. Family II. CYPERACEAE.
- Perianth of two distinct series, both chaffy and much alike but not glumaceous: fruit a capsule. Family III. JUNCACEAE.

I. GRAMINEAE. THE GRASS FAMILY

Fibrous rooted annual or perennial herbs with hollow cylindrical stems with leaves in two rows their blades long and narrow and parallel veined, their bases forming an open sheath around the stem; inflorescence a more or less branched panicle composed of small spikelets of flowers subtended by two empty glumes: spikelets 1- to several-flowered: flower consisting of 2 glumes (the flowering glumes) usually 3 stamens, a two-parted pistil with mostly feathery pistils and a single ovary which becomes the grain or "seed."

KEY TO THE TRIBES

- Spikelets falling from the pedicels entire, naked or inclosed in bristles or bur-like involucre, 1-flowered or if 2-flowered the lower flower staminate; no upper empty glumes: rachilla not extending above the upper glume.
- Flowering glumes hyaline, thin, much more delicate in texture than the empty glumes.
- Spikelets in pairs, one sessile, the other pedicellate. Tribe I. ANDROPOG.
- Spikelets not in pairs, (*Alopecurus*, *Poly-pogon*, *Cinna*, etc.) Tribe II. ZOYSIEAE.
- Flowering glume, at least that of a perfect flower, similar in texture to the empty glumes, or thicker and firmer, never hyaline and thin.
- Flowering glumes membranous; the first empty glume usually larger than the rest. Tribe V. AGROSTIDEAE.

KEY TO THE TRIBES

Flowering glumes papery to leathery, very different in color and appearance from the empty glumes.

Tribe III. PANICEAE.

Spikelets with the rachilla jointed above the empty glumes which persist, 1- to many-flowered; frequently the upper glumes are empty; rachilla often prolonged beyond the upper glume.

Spikelets borne in an open or spike-like panicle or raceme, usually upon distinct pedicels.

Spikelets 1-flowered.

Empty glumes 4; palea 1-nerved.

Tribe IV. PHALARIDAE.

Empty glumes 2, rarely 1; palea 2-nerved (except in *Cinna*).

Tribe V. AGROSTIDAE.

Spikelets 2- to many-flowered.

Flowering glumes usually shorter than the empty glumes; the awn dorsal and usually bent.

Tribe VI. AVENAE.

Flowering glumes usually longer than the empty ones; the awn terminal and straight or none.

Tribe VIII. FESTUCAE.

Spikelets in two rows, sessile or nearly so.

Spikelets on one side of the continuous axis, forming one-sided spikes.

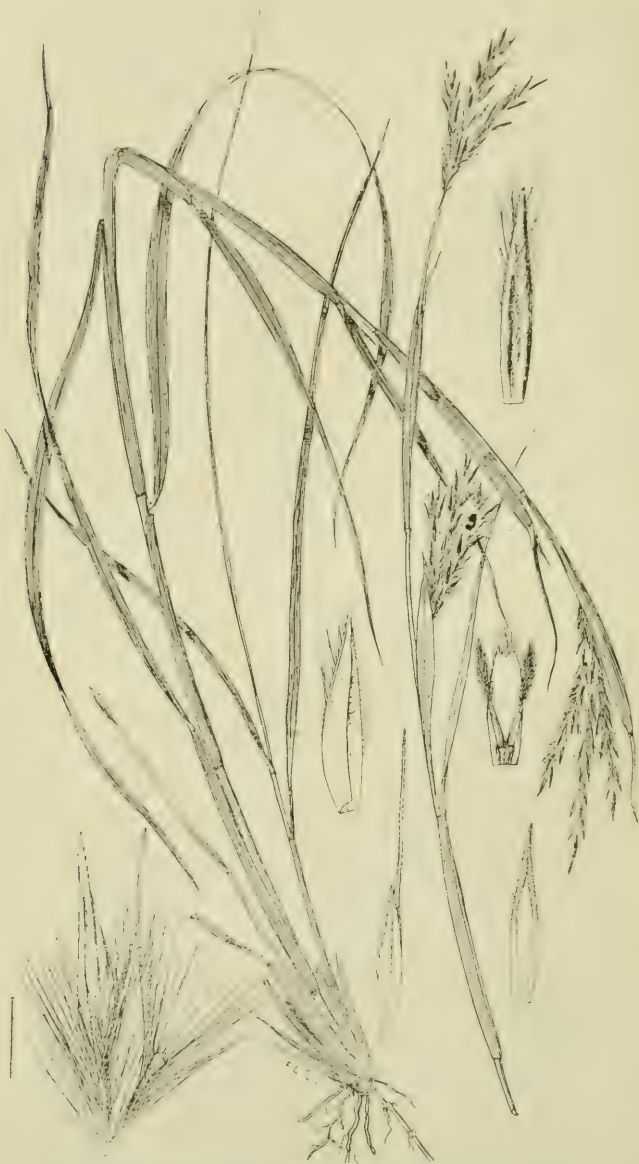
Tribe VII. CHLORIDAE.

Spikelets alternately on opposite sides of the axis which is often jointed.

Tribe IX. HORDEAE.



SAGE GRASS. (*Schizachyrium scoparium*)



TALL SAGE GRASS (*Andropogon hallii*.)

The Sage Grasses.

(Tribe 1. ANDROPOGONEAE). These are large, coarse, bunch grasses of very little economic importance in any way. They are rarely if ever abundant in any one place, though on account of their size and the conspicuous inflorescence of some species they attract the attention of the casual observer. As a group they are adapted to warm, dry situations, occurring on dry hillsides, rocky hills, on sand hills and in arroyos, while two of the native species are easily eradicated weeds in the fields and along the roadsides and ditch banks. The different genera are rather easy to distinguish as they occur in New Mexico. *Andropogon*, represented by two species, found only in the mountains, or on the plains of the eastern side of the State, is a tall grass generally 4 to 5 feet tall with coarse leaves and a 2-4 branched panicle of hairy spikelets. The divisions of the panicle are $\frac{1}{2}$ an inch in diameter and 2 to 4 inches long. The stalks are never very numerous, usually from 2 to half a dozen in a "bunch." It is the TALL SAGE GRASS. The other native species are usually about $2\frac{1}{2}$ feet tall and grow in good sized "bunches," forming tufts a foot in diameter very frequently. *Schizachyrium* is the smaller SAGE GRASS wherever it occurs, and it is not uncommonly associated with the tall plants both in the mountains and on the sand hills and plains, though it is much more common. It may be distinguished by the slender interrupted panicle of few spikelets covered with slender spreading hairs. *Amphilophis* is not generally referred to as a sage grass but is a close relative of the others. Economically two of the species are somewhat important because they occur as weeds in the cultivated valleys. They are bunch grasses often forming tufts a foot or more in diameter and 2 to 3 feet high. Their panicles

consist of 5 to 10 subdivisions 2 to 3 inches long and $\frac{1}{4}$ of an inch in diameter all arising from the top of the culm. There are numerous crowded spikelets covered with whitish, spreading, silky, stiff hairs forming a plume like panicle.

One species of the genus (*Sorghastrum nutans*) which occurs sparingly in the mountains is eaten by stock when green, but is of little importance because there is little of it, and that little is not very good. With this exception the native species of the tribe are rarely if ever touched by grazing animals. When first beginning to grow in the summer if other feed is scarce they may be eaten. Usually however, they do not start until after other plants have grown and they are allowed to dry, when they are of no value. The other native species listed in detail below are not of sufficient importance to receive notice here.

Johnson Grass (*Sorghum halapense* (L) Pers.) is never referred to as a sage grass, so far as the author knows, but it is related to them and belongs in the same tribe. It is too well known to need description. It has very pronounced enemies and some friends, because under certain conditions it is a very troublesome plant and under others it is quite beneficial. The difficulty of keeping these facts separate in one's mind is the cause of the sometimes violent denunciation and equally strenuous upholding of the plant in farming communities. Johnson grass is thoroughly at home in a rich moist soil in a hot climate and grows luxuriantly. It is so thoroughly able to "crowd" that it soon rules supreme in such locations. It will not grow in a very dry soil and is easily dried out in an arid region. For this very reason there is little probability of its ever becoming a serious pest any place in the arid region. It may become considerable of an inconvenience however in cultivated irrigated fields, because it gets on the ditches and drops its seeds in the irrigating water and is planted in the sediment when the water sinks into the ground. It has caused some trouble to alfalfa growers in the Mesilla Valley but there is little doubt that

it can be controlled quite readily. It has its advantages also as a pasture grass for milch cows, and a really good grass for this purpose in New Mexico is hard to find. It is by no means an excellent one but is better than any other so far tried. It will only grow at the lower and hotter levels, but here it does well, and the prejudice against it is very largely unwarranted, so long as it is not allowed to go to seed. As a hay crop it cannot compare with alfalfa.

Tribe I. ANDROPOGONEAE.

Spikelets sessile and pedicellate, the former perfect, the latter empty, staminate, or wanting.

First empty glume of the sessile spikelet not balsam bearing.

Sessile spikelets all alike, throughout the inflorescence.

Racemes single; a cup-shaped appendage at the tip of the clavate rachis joints.

Racemes in pairs or more numerous; rachis joints not appendaged.

Rachis joints and pedicels sulcate and translucent.

Rachis joints not sulcate nor translucent.

Some of the racemes sessile.

All of the racemes pedunculate.

Pedicellate spikelet wanting.

Pedicellate spikelet present.

Lower spikelet different from the others.

First empty glume of the sessile spikelet balsam bearing.

Spikelets all pedicellate, the long pedicellate one perfect, the short pedicellate one staminate.

1. SCHIZACHYRIUM.

2. AMPHILOPHIS.

3. ANDROPOGON

4. SORGHASTRUM.

5. SORGHUM.

6. HETEROPOGON.

7. ELIONURUS.

8. TRACHIPOGON.

I. SCHIZACHYRIUM Nees. SAGE-GRASS

Pedicels clothed with long silky hairs.

Peduncles long and slender, much exserted, twisted below the spike; spikes single.

Peduncles not much exserted from the sheaths.

Hairs on the pedicels very few or none, short when present.

1. *S. neo-mexicanum*.

2. *S. scoparium*.

3. *S. cirrhatum*.

1. *Schizachyrium neo-mexicanum* Nash. In dry rocky situations in low mountains in the Upper Sonoran Zone. It is probably too near the next to be maintained. Further study will determine.

2. *Schizachyrium scoparium* (Michx.) Nash. Fairly common in the mountains on the drier slopes in pine timber or in gullies and dry water courses in the higher plains, especially in the northern and eastern part of the state. Upper Sonoran and into the Transition Zones.

3. *Schizachyrium cirrhatum* (Hack.). A rather rare grass known in this State only from the drier mountains and hills of the southwestern part. Sonoran Zones.

2. AMPHILOPHIS Nash.

Hairs on the rachis and pedicels shorter than the spikelets.

1. *A. wrightii*.

Hairs on the rachis and pedicels longer than the spikelets.

Awns 10 mm. long or less; panicles smaller than in the next.

2. *A. saccharoides*.

Awns more than 10 mm. long; panicles larger and much hairier than No. 2.

3. *A. leucopogon*.

1. *Amphilophis wrightii* (Hack.) Nash. Comes into New Mexico from Sonora and Arizona. Known only from the mountains of the southwestern part. Sonoran Zones.

2. *Amphilophis saccharoides* (Sw.) Nash. This is the *Andropogon torreyanus* of various authors. It is a common roadside and ditch bank weed of the Rio Grande and Pecos Valleys and occurs sparingly in the arroyos leading into these valleys. From Albuquerque south. Lower Sonoran Zone.

3. *Amphilophis leucopogon* (Nees) Nash. This is the *Andropogon saccharoides* of various authors, not of Sw. It is associated with the preceding species but is much the more common; it also occurs frequently in the mountains up to about 6000 feet. In the Sonoran Zones.

3. ANDROPOGON L. TALL SAGE GRASSES

Fourth glume of the sessile spikelet with a long bent awn, more or less twisted at the base.

1. *A. chrysocomus*.

Fourth glume of the sessile spikelet awnless, or with a short, straight, untwisted awn.

2. *A. hallii*.

1. *Andropogon chrysocomus* Nash. On dry hill-sides or open places in the mountains at elevations of from 6000 to 7500 feet in the transition zone. It is never very abundant in any one location.

2. *Andropogon hallii* Hack. On the plains and sand hills of the eastern tier of counties, coming in from farther east. In some places it is not uncommon and is always conspicuous on account of its size. In the Upper Sonoran Zone.

4. *SORGHASTRUM* Nash.

1. *Sorghastrum nutans* (L.) Nash. Widely distributed in the mountains throughout the State at elevations of from 6000 to 7500 feet and on the plains in the northeast corner; in the Transition Zone. Never very abundant in any place.

5. *SORGHUM* Pers.

1. *Sorghum halapense* (L.) Pers. The common JOHNSON GRASS has been introduced at several places in the irrigated valleys in the southern part of the state, and occurs as a weed in fields and on ditch banks. Lower Sonoran Zone.

6. *HETEROPOGON* Pers.

1. *Heteropogon contortus* (L.) Beauv. Is known only from the hot dry mountains of the southern part of the State. In the Sonoran Zones.

7. *ELIONURUS* H. & B.

1. *Elionurus barbicu'mis* Hack. A Mexican species known in New Mexico from a single collection from the extreme southwestern corner near the boundary line. Lower Sonoran Zone.

8. *TRACHYPOGON* Nees.

1. *Trachypogon plumosus* (H. and B.) Nees. Another Mexican species known only from the extreme southwestern corner of the State. In the Lower Sonoran Zone.



JOHNSON GRASS. (*Sorghum halapense*.)



TOBOSA GRASS. (*Hilaria Mutica.*)

The Galleta Grasses . TRIBE II ZOYSIEAE

The common name as used here is rather stretched in its meaning, but is treated in this way for lack of any other to cover a group which is a very important one, even though the number of species is small. The name GALLETA GRASS (gah-yet-ta) is applied locally by the Mexican people to one species or sometimes to two species of *Hilaria*, (*H. jamesii*, and *H. mutica*) usually and possibly more properly to the former, while the latter is more frequently called TOBOSA. The other species of the genus is probably the same as the TEXAS MESQUITE GRASS, so much prized by stockmen.

This group of grasses is probably second in importance only to the Grama grasses in New Mexico. The GALLETA GRASS proper (*H. jamesii*) occurs commonly over the higher plains and in the higher mountains from about 5500 to 7000 feet, associated with the blue or white Grama and produces a large part of the forage. It is not only abundant but it is very nutritious, being especially well liked by horses; and stockmen agree that it will fatten horses more quickly and put better flesh on them than any of the grasses. It is not easily tramped out, because of the large rootstocks that are more or less protected in the ground and which are hard to kill. It is sometimes called black Grama by stockmen though this is usually done to distinguish it from the true Grama with which it most frequently occurs. It is not closely related to the Gramas nor does it look like them in the least. It grows in "bunches" but in favorable locations the bunches may be near enough together to form almost a sod. It is from 12 to 18 inches high when growing under favorable conditions of soil and moisture, produces numerous rather wiry, rough, dull-green leaves and a cylindrical panicle or spike from 3 to 5 inches long and $\frac{1}{4}$ inch in diameter or slightly less. The spikelets are set rather close together and are covered with spreading hairs. At first the spike is compact and slightly tinged with purple, but in age the spikelets spread, and the hairs diverge and the spike is almost

white. The plant spreads slowly by its rootstocks, which are short and thick, but it never forms a compact sod.

The TOBOSA GRASS occupies a position of the same relative importance in the southern third of the State as the Galleta does in the cooler plains and mountains. It closely resembles the other species but is coarser, drier and tougher; it is distinctly a bunch grass, forming tufts 8 inches to a foot in diameter with numerous curved and spreading stems from a single root. It usually occurs on open flats that have a fine more or less compact soil and are not infrequently flooded in the rainy season. It seems well adapted to such places, since it can endure flooding for days and even weeks without being "drowned out," and it can endure long periods of drought, apparently with equal ease. Where the soil is good and there is abundance of water, almost pure stands of this species occur in patches of from a few square yards to one or two acres in extent. It is about 15 to 20 inches high, when well grown, has the same dull bluish-green color and harsh leaves, the same sort of a cylindrical hairy spike as the Galleta grass. When dry it is not of much value as forage for stock will not eat it—it is too hard and woody and is apt to turn somewhat blackish. In this condition it may be recognized by the peculiar bunches of curved stems forming an unsymmetrical tuft. But stock accustomed to it thrive on it during the growing season, which occurs just after the summer rains. It is like the Galleta grass in having thick rhizomes and being hard to trample out. This makes it valuable in the region it inhabits which has a loose sandy soil easily drifted about by the wind, thus exposing the roots to trampling. It is usually associated with the true Black Grama (*Bouteloua eriopoda*) and a grass known as Needle Grass (*Scleropogon brevifolius*), both of which are discussed at length in their proper places, and is a very important source of forage within its range. It has already become more important than the black Grama on some parts of the range because it is not liked so well by cattle and also because it is better able to stand trampling.

The third species, doubtfully referred to here as the TEXAS CURLY MESQUITE GRASS (*II. cenchroides*), is a small grass which spreads over the ground by means of runners forming a pretty compact sod. It is not so coarse as either of the other species rarely being over about 5 or 6 inches high. The panicle is a slender, cylindrical, somewhat interrupted spike, 2 inches or so long, of small purplish florets. The leaves are short and rather numerous, and not nearly as coarse and tough as those of the larger species mentioned above, and for this reason is a better feed. Its habit of spreading by runners is also important for it makes it an aggressive spreading plant not dependent upon seed germination for reproduction. The reason for expressing doubt as to the correctness of the determination of this species lies in its peculiar distribution. It is known from New Mexico only from the southwestern part in the region of Silver City and nowhere in between the Texas region where it is abundant. This is hardly due to failure to collect it in the intermediate region for a number of good collectors and a few grass specialists have collected in this region and have not found it. The other suggestion is that the New Mexican plant is a little known Mexican species coming in from the south and incorrectly identified here. Be that as it may, it is a good grass and needs to be encouraged to spread further in a region where sod forming grasses are very scarce.

The other grass in this group (*Nazia aliena*) is a small annual of no economic importance. It may be recognized by its strict cylindrical spike of small hook-covered "seeds" somewhat like small clothburs.

Tribe II. ZOYSIEAE

Second glume not spiny.

9. HILARIA.

Second glume with hooked spines.

10. NAZIA.

9. HILARIA H. B. K.

Bases of the glumes with black or purplish glands; plants low, spreading by slender runners.

1. *II. cenchroides*.

Glumes not glandular; plants taller, forming bunches, rootstocks short and thick, subterranean.

Outer glumes cuneate, awnless, nerves diverging.

2. *H. mutica*.

Outer glumes linear or oblong, awned.

3. *H. jamesii*.

1. ***Hilaria cenchroides*** H. B. K. TEXAS CURLY MESQUITE GRASS. Known from but a restricted region in the southwestern part of the State, in the Upper Sonoran Zone.

2. ***Hilaria mutica*** (Benth.) Buckley. TOBOSA GRASS. Common on the plains and to some extent on hills of the southern part of the State, in the Lower Sonoran Zone.

3. ***Hilaria jamesii*** (Torr) Benth. GALLETA GRASS. Common on the upper plains and to a limited extent in the mountains up to elevations of 7,000 feet in the northern two-thirds of the State; in the Upper Sonoran and Transition Zones.

10. **NAZIA** Adans.

1. ***Nazia aliena*** (Spreng.) Scrib. Not uncommon on the low mountains and mesas of the southern part of the State in the Upper Sonoran Zone.

The Panic Grasses and their relatives.

(Tribe III. PANICEAE) This tribe of grasses is a very large and important one, more from their abundance as weeds than for their usefulness as forage plants, though some of the species are valuable for the latter purpose. The group contains such well known grasses as the Sand Bur, Foxtail, Barnyard Grass, Crab-grass and the Panic Grasses proper, several of which are common field and garden weeds. These weedy species are almost without exception introduced into New Mexico, many of them from the Old World, and are well fitted for the conditions supplied in cultivated fields in temperate climates the world over. They are able to

compete with most field crops and produce abundance of seeds which are scattered in one way or another, largely by man himself. We need say only a few words about each as they are discussed more at length in a bulletin on weeds.

SAND BUR (*Cenchrus tribuloides*) is common in door yards and in fields, especially hay fields, in the late summer. The seeds are distributed widely by man and domestic animals. The plant is particularly pestiferous in alfalfa fields, and an aggravating nuisance in door yard grass plats.

Two species of FOXTAIL (*Chactochloa glauca* and *C. viridis*) are common in fields and gardens, their seeds probably having been introduced with garden seeds. BARN-YARD GRASSES (*Echinochloa* spp.) of which there are about four well marked forms, usually occur on lands which have been fertilized with stable manure and have been flooded. They will not grow in very dry soil. Under certain conditions one of them is sown for the crop of coarse, poor hay that it produces, but this is done only to prevent entire loss of crop on the land for the season. Land that for any reason is too wet for most hay crops may sometimes be sown in Barnyard grass and make a crop that is somewhat better than nothing. The grass is tall, coarse and succulent and the hay is hard to cure perfectly and if not properly cured it is apt to mould. It produces a very heavy tonnage of green fodder but is not of good quality and not much relished by animals.

CRAB-GRASS (*Syntherisma sanguinale*) is very well known to the average farmer especially if he has lived in the Southern States. It is one of the most common weeds in cotton fields. It is not very common in New Mexico because the region is too dry. It occurs sparingly as a door yard weed.

Several of the true *Panicums* listed below, one of which is the common sprangling "tickle grass," as the children call it, and all of which resemble it somewhat, are common or

rare weeds in the fields, gardens and orchards, usually appearing in the late summer in fields from which crops have been taken or orchards that have not been properly cultivated. Most of them are not hard to kill out and some of them are eaten by stock allowed to run in such fields. Pastures that are run down are apt to contain them. The species of *Eriochloa* mentioned below (it has no vernacular name) is of common occurrence under such conditions and is of no importance otherwise. None of the species so far mentioned grow on the open ranges, neither on the plains or mesas nor in the timbered areas, hence are not available to the stock that might and probably would eat them.

One of the species of *Paspalum* mentioned below is a common creeping grass with a two parted panicle, each division having the small seed-like spikelets arranged in a single row on one side of the rachis. It will grow only in very wet soil and is a common weed in the bottoms of the smaller ditches, the seeds germinating in the muddy sediment deposited from the water, where it is a great nuisance. The other two species are rare in the eastern part of the State, coming in from Oklahoma and Texas, and are of little importance.

Of the remaining species listed in the tribe several are of more or less importance but they mostly have no common names by which to refer to them. The single species of *Valota* is a not infrequent bunch grass in the foot-hills of the mountains in rocky gravelly soil where it forms a small though not unimportant part of the wild forage crop. It is about 18 inches to 2 feet high, grows in small scattered bunches and has a fine white wooly panicle 4 to 6 inches long.

VINE MESQUITE GRASS (*Panicum obtusum*) is a species which is common on the plains and some places in the valleys over a large part of the State. It may be recognized by the slender panicle, 8 inches to a foot high, of

relatively large "seeds" and the long wiry runners by which it spreads over the ground. It is best adapted to fine compact soils and requires rather more water than the average of the native perennial grasses. It is not uncommonly a weedy encroacher in pastures and fields and is not very good feed, though stock eat it when it is green and tender or when there is nothing better available.

There are four large species of *Panicum* (Nos. 13, 14, 15, and 16, listed below) which are tall (2 to 4 feet) bunch grasses with thickened bulb-like bases to the stems or short underground stems by which they propagate. They occur mostly in the mountains, sometimes in arroyos leading from the mountains, and are tolerably important forage plants. The panicles are usually large and widely spreading with rather large rounded spikelets on the ends of long and slender branches. During the summer time they are freely eaten by stock everywhere they occur.

Mr. J. K. Metcalfe grew two of them quite successfully in his small garden, demonstrating their fitness for cultivation. They do not germinate readily, hence do not spread rapidly, nor do they cure standing as several of the Grama grasses do. As grasses to be cultivated they can not compare with several of the common cultivated forage plants. As grasses able to grow in mountain canons and rock crevices they are important.

ITALIAN MILLET, German Millet or Hungarian Grass are all names for a cultivated form of *Chaetochloa* (*C. italica*) which is rather like a large Foxtail grass. It has been selected for size for a long time and the ordinary cultivated forms have heads 4 to 5 inches long and often an inch in diameter. They produce large quantities of seed and much forage and the grass is used considerably in cultivation. It will probably be grown more in New Mexico as farmers learn its value.

Another species of this genus which promises to be of

some value especially in the southern part of the State is the native *Chaetochloa composita* which has not yet reached the dignity of a common name. Experiments in growing it in the garden show that the seeds germinate rather readily and the plant does well on the light dry soils of the mesas. It is a short lived perennial producing an abundance of seeds in a cylindrical spike which is somewhat like the foxtail grasses but not so hairy.

Tribe III. PANICEAE.

Spikelets with involucre; involucre of two spiny valves.

Spikelets naked, i. e., without involucre.

Empty glumes awned.

Empty glumes not awned.

Spikelets in one-sided simple or branched racemes.

Spikelets ovate to orbicular, obtuse.

Spikelets lanceolate, acute to acuminate.

Spikelets in panicles or panicled racemes, not 1-sided.

A swollen ring at the base of the first glume.

Swollen ring wanting.

Spikelets lanceolate, covered with long white hairs.

Spikelets mostly orbicular, sometimes lanceolate and pubescent, but never conspicuously white hairy as in 17.

Flowering glume inrolled at the edges, thin; first glume always conspicuous.

Flowering glume not inrolled, thick and leathery; first glume very small or wanting.

11. CENCHRUS.

12. CHAETOCHLOA.

13. ECHINOCHLOA.

14. PASPALUM.

15. SYNTHESISMA.

16. ERIOCHLOA.

17. VALOTA.

18. PANICUM.

19. LEPTOLOMA.



ITALIAN MILLET. (*Chactochloa italica*.)



BULBOUS PANIC GRASS. (*Panicum bulbosum*.)

11. *CENCHRUS* L.

1. *Cenchrus tribuloides* L. SAND BUR. Common in the cultivated areas throughout the State though more common at the lower levels: a troublesome weed.

12. *CHAETOCHLOA* Scribn.

Panicles spike-like, dense, with numerous, crowded spikelets.

Spikelets arranged singly in racemes; 5-16 bristles at the base of each spikelet, somewhat tawny.

1. *C. glauca*.

Spikelets clustered, not in racemes; 1-3 bristles at the base of each spikelet, bright green.

2. *C. viridis*.

Panicles more slender and interrupted, sometimes slightly spreading.

Leaf blades mostly more than 1-4 inch wide; panicles slightly branched below.

3. *C. griesbachii*.

Leaf blades less than 1-4 inch wide; panicles cylindric, not showing branches, a short lived perennial.

4. *C. composita*.

1. *Chaetochloa glauca* (L.) Scribn. FOXTAIL. A common field weed at several places in the State where it has been introduced with garden and field crops. Probably much more common than the records show.

2. *Chaetochloa viridis* (L.) Scribn. FOXTAIL. Very similar to the last in general appearance, but greener. It is a very common field weed all over the State wherever crops are grown.

3. *Chaetochloa griesbachii* (Fowm.) Scribn. var. *ampla* Scribn. and Merrill. A rather rare grass in the mountains of the southern part of the State, in the Upper Sonoran Zone.

4. *Chaetochloa composita* (H. B. K.) Scribn. Common on the lower mesas and in the foothills in the southern half of the State, in the Sonoran Zones.

5. *Chaetochloa italica* (L.) Scribn. ITALIAN MILLET. Hungarian Grass. Is cultivated in a few places in the eastern part of the State and will probably be more cultivated as population increases. It is apt to escape. It may be recognized by the much thicker panicle often 1 inch in diameter, of crowded spikelets.

13. ECHINOCHLOA Beauv.

Panicles simple, spike-like; plant usually low and spreading.

1. *E. colona*.

Panicles branched, plant much taller when mature, spreading when young.

2. *E. crus-galli*.

1. *Echinochloa colona* (L.) A not uncommon grass in irrigated land in the southern part of the State; in the Sonoran Zones. A variety having purplish bands across the leaves is var. *zonalis*.

2. *Echinochloa crus-galli* (L.) Beauv. BARNYARD GRASS. The species, having awns about 1 inch long is not very common but the variety *mutica* with awns about $\frac{1}{8}$ of an inch long is a very common field weed especially on fallow lands which get flooded. Most common in the Lower Sonoran Zone.

14. PASPALUM L.

Stems rooting at the joints, panicle with two terminal racemes.

1. *P. distichum*.

Stems not rooting at the joints, more or less erect; branches of the panicle more than two.

Spikelets on short pedicels; plant almost glabrous, the slender hairs almost all confined to the leaf margins.

2. *P. ciliatifolium*.

Spikelets sessile or nearly so; plant more or less villous with slender stiff hairs, especially on the leaves and sheaths.

3. *P. Bushii*.

1. *Paspalum distichum* L. A common weed in the ditches and on flooded land in the southern part of the State. Lower Sonoran Zone.

2. *Paspalum ciliatifolium* Michx. Known only from a single collection near Roswell. Probably not uncommon in the eastern part of the State.

3. *Paspalum bushii* Nash. A rare grass, found on the plains in the northeastern part of the State. Upper Sonoran Zone.

15. SYNTERISMA Walt.

1. *Syntherisma sanguinale* (L.) Dulac. CRAB GRASS. Common as a field and garden weed in the warmer cultivated val-

leys, where it has been introduced; mostly in the Lower Sonoran Zone.

16. ERIOCHLOA H. B. K.

1. *Eriochloa punctata* (L.) Hamil. Not uncommon in fields and orchards in the cultivated valleys in the southern part of the State, late in the summer. Lower Sonoran Zone.

17. VALOTA Chase.

1. *Valota saccharata* (Buckl.) Chase. Common on the plains and the foothills of the drier mountains throughout the State, though never abundant; in the Upper Sonoran Zone.

18. PANICUM L.

Spikelets arranged in pairs in 1-sided racemes; plant spreading by long prostrate rooting stems.

Spikelets panicle, not 1-sided; creeping stems wanting.

Leaf blades of two sorts, those of the stem broad and short (Subgenus *Dichanthellum*).

Spikelets over 3 mm. long; leaf blades thin; sheaths glabrous or sparingly hispid.

Spikelets not over 3 mm. long; leaf blades firm; at least some of the sheaths hispid.

Leaf blades all alike (*Panicum* proper).
Annuals.

Inflorescence of several more or less second spike-like racemes.

Spikelets strongly reticulate veined, glabrous.

Spikelets not reticulate veined, finely pubescent and papillose-hirsute.

Inflorescence a more or less diffuse panicle.

First glume very short, not over 1-4 the length of the second; sheaths glabrous.

First glume longer, 1-2 as long as the second or longer; sheaths papillose-hispid.

Panicle more or less drooping; cultivated plant.

Panicle erect; plant not cultivated.

Panicle large, more than half the length of the entire plant.

1. *P. obtusum*.

2. *P. helleri*.

3. *P. scribnerianum*.

4. *P. fasciculatum*
chartiginense.

5. *P. arizonicum*.

6. *P. dichotomiflorum*.

7. *P. miliaceum*.

8. *P. barbipulvinatum*.

Panicle smaller, not over 1-3 the length of the plant.

First glume more than 3-4 the length of the second; spikelet 4 mm. long.

9. *P. pampinosum*.

First glume 1-2 to 2-3 the length of the second; spikelet not over 3.3 mm. long.

10. *P. hirticaule*.

Perennials.

Stems not bulbous nor rhizomatous.

Sterile palea enlarged and hardened at maturity expanding the spikelet; glumes acute; an introduced plant in the fields.

11. *P. hians*.

Sterile palea not enlarged; glumes acuminate; native plant in the mountains.

12. *P. hallii*.

Stems bulbous at base or rhizomatous.

Glumes acuminate.

Spikelet 3 to 5 mm. long; 1st glume long acuminate to cuspidate; rhizomes several inches long and scaly.

13. *P. virgatum*.

Spikelets 6 to 8 mm. long; 1st glume acute; rhizomes shorter.

14. *P. havardii*.

Glumes obtuse or merely acute, never acuminate.

Culms from a rootstock, not bulbous.

15. *P. plenum*.

Culms from an enlarged bulbous base.

16. *P. bulbosum*.

1. *Panicum obtusum* H. B. K. VINE MESQUITE GRASS.

Common at lower levels in the southern part of the State and up to about 6000 feet altitude in the northeastern corner. It does not occur frequently in the mountains. In the Sonoran Zone.

2. *Panicum heileri* Nash. Known from a single collection in the Mogollon Mountains at about 7500 feet altitude. In the Transition Zone.

3. *Panicum scribnerianum* Nash. Collected but once; at Las Vegas. In the Upper Sonoran Zone. (?).

4. *Panicum fasciculatum chartiginense* (Sw.) Doell. An introduced field weed collected once at Socorro. Lower Sonoran Zone.

5. *Panicum arizonicum* Scribn. and Merr. A small annual not uncommon in the foothills of the mountains of the southern part of the State after the summer rains. Upper Sonoran Zone.

6. *Panicum dichotomiflorum* Michx. Known from a single collection near Las Cruces. Lower Sonoran Zone.

7. *Panicum miliaceum* L. HOG MILLET. Sparingly cultivated at different places in the State and occasionally escaped.

8. *Panicum barbipulvinatum* Nash. Children call it "tickle grass." A common field and garden weed in cultivated land throughout the State.

9. *Panicum pampinosum* Hitchc. and Chase. Occasional in the drier mountains of the southern part of the State. Upper Sonoran Zone.

10. *Panicum hirticaule* Presl. Very similar to the preceding, with a similar distribution. Upper Sonoran Zone.

11. *Panicum hians* Ell. Collected once in fields at Las Cruces. Lower Sonoran Zone.

12. *Panicum halli* Vasey. On the plains of the eastern part of the State and in the mountains of the southern part. Upper Sonoran Zone.

13. *Panicum virgatum* L. In the mountains, not very common. In the Transition Zone.

14. *Panicum havardii* Vasey. On the plains of the eastern side of the State. In the Sonoran Zones.

15. *Panicum plenum* Hitchc. and Chase. In the drier mountains of the southern and southwestern part of the State. In the Upper Sonoran Zone.

16. *Panicum bulbosum* H. B. K. A fairly common grass in the mountains throughout the State at elevations of from 6000 to 8000 feet. In the Transition Zone. A smaller plant of the same general pattern is var. *sciaphilum* (Rupr.) H. and C. which occurs most frequently in the southern part of the State; except for size it is hardly distinguishable from the species.

19. LEPTOLOMA Chase.

1. *Leptoloma cognata* (Schultes) Chase. Known in New Mexico from a single specimen collected in the gardens at Las Cruces. An introduced weed.

The Canary Grass and its relatives (Tribe IV, PHALARIDEAE) need only be mentioned. A single unimportant species has been collected a few times in Grant County, where it probably was introduced. Two other species, one of them introduced, have been collected in the State.

Tribe IV. PHALARIDEAE.

Third and fourth glumes empty, awnless.	20. PHALARIS.
Third and fourth glumes enclosing staminate flowers.	21. SAVASTANA.

20. PHALARIS L. CANARY GRASS.

1. *Phalaris caroliniana* Walt. Has been collected in several places in Grant County in the Upper Sonoran Zone.

2. *Phalaris angustata* Nees. A single specimen from Mangas Springs, was probably cultivated.

21. SAVASTANA Schwank.

1. *Savastana odorata* (L.) Scribn. Occurs sparingly in the mountains at the northern end of the State, in the Transition Zone.

The Tribe Containing Red-top and its relatives (Tribe V, AGROSTIDEAE) is a very important one, including as it does some of the largest genera that we have in the State. It contains the Needle Grasses, Porcupine Grasses, Mountain Rice, the genus *Muhlenbergia* with over twenty species, Wild Timothy, the Dropseed Grasses, Red-top and several other genera of less importance. It will be necessary to take them up somewhat in detail and refer to particular species some of which have common names and some have not.

The following key will assist in finding the generic names; the species are found following the discussion of each genus.



NEEDLE GRASS. (*Aristida longiseta*.)



PORCUPINE GRASS. (*Stipa comata*.)

Tribe V. AGROSTIDEAE

- Flowering glumes considerably hardened when mature and closely enclosing the grains, or at least firmer than the empty glumes.
 Spikelets all perfect, not in pairs.
 Flowering glume 3-awned (two sometimes very small). 22. ARISTIDA.
- Flowering glume 1-awned.
 Awn twisted and bent. 23. STIPA.
- Awn not twisted.
 Flowering glumes broad; awns deciduous.
 Flowering glumes glabrous, or pubescent with short appressed hairs. 24. ORYZOPSIS.
- Flowering glumes pubescent with long silk hairs much exceeding the glume. 25. ERIOCOMA.
- Flowering glumes narrow; awns persistent. 26. MUHLENBERGIA.
- Spikelets in pairs, one perfect, the other staminate or sterile, in spike-like panicle. 27. LYCURUS.
- Flowering glumes usually thin at maturity, at least more delicate than the empty glumes; grain loosely enclosed.
- Stigmas subplumose (i. e., with short hair all around), projecting from the apex of the nearly closed glumes; inflorescence spike-like, cylindrical and crowded.
- Rachilla of the spikelet jointed above the empty glumes which are therefore persistent. 28. PHLEUM.
- Rachilla of the spikelet jointed below the empty glumes, and the spikelets therefore fall off entire. 29. ALOPECURUS.
- Stigmas plumose, projecting from the sides of the panicle; panicle mostly open and spreading, sometimes crowded and spike-like.
- Grain not permanently enclosed in the flowering glumes; pericarp opening readily at maturity.
- Flowering glumes long hairy on the veins. 33. BLEPHARONEURON.
- Flowering glumes not hairy on the veins. 30. SPOROBOLUS.
- Grain permanently enclosed in the flowering glumes; the pericarp adherent.
- Spikelets readily falling off when mature. 31. POLYPOGON.
- Spikelets with the empty glumes at least persistent.
- Innermost glume (palea) 1-nerved and 1-keeled; 1 stamen. 32. CINNA.
- Innermost glume 2-nerved and 2-keeled, or sometimes wanting; stamens 3.
- Flowering glumes naked at the base. 35. AGROSTIS.
- Flowering glumes with long hairs at the base.
- Flowering glume and palea thin membranaceous. 36. CALAMAGROSTIS.
- Flowering glume and palea chartaceous. 37. CALAMOVILFA.

The Needle Grasses of the genus *Aristida* occur all over the State and are easy to recognize. They all agree (except one species) in having the scale (glume) which surrounds the seed prolonged into a three pronged beard (awn) the subdivisions of which are an inch or two long, slender and divergent when the seed is ripe. The single exception has one tolerably long awn and the other two are very short or entirely absent. The base of the "seed" is very sharp pointed and has a tuft of rather stiff hairs. The peculiar arrangement of the awns, the point and the tuft of hairs doubtless have considerable to do with the distribution of the plant, probably being instrumental in scattering and planting the seeds.

Speaking generally of the whole genus (which has a rather large number of species) it is correct to say that they deserve the common name often given them of "Poverty grass" because they are not valuable as forage and because their presence in abundance on any area indicates a dearth of good feed. They are present in abundance only where better grasses have been killed out or where the climatic and soil conditions are so unfavorable that other and better species will not grow. They are very rarely eaten by stock, possibly because they are not palatable, but much more probably because the "seeds" are very spiny and penetrate the tongues of the animals.

Most of them are bunch grasses, in the sense that they form more or less compact tufts and spread very little. All except one of our species are perennials and they occur everywhere throughout the State except at very high altitudes, though they are much more common on the hotter plains. The annual species (*Aristida bromoides*) frequently covers large areas after the summer rains, but its dominance in an area tells at once that the better grasses have been eaten out and that this species is present in such abundance because it has been assisted in gaining a foothold by the destruction of the economically much better species.

Another one of the needle grasses that is easily recognized is the one with very long beards called *Aristida longiseta*. In New Mexico this species is usually about 8 inches to 1 foot high growing in a very dense tuft with many erect stems and numerous slender curled leaves. The heads are rather slender, the beards are about 2 inches or more long, colored a reddish purple when in full flower, and the two chaffy glumes which enclose the "seed" are of very unequal length, the longer reaching above the base of the spreading awns. The Latin name for this is particularly appropriate as it certainly is the LONG-AWNED NEEDLE GRASS. It is very common on some parts of the range since it is a very hardy and resistant plant; but it is of little or no value as feed for the reason mentioned above.

Two species with widely spreading rigid stems and panicles occur commonly on the sandy land especially at the south end of the State. They look very much alike but one of them has three awns about an inch long and the other has but one. The plants frequently cover an area of more than a square foot and are a foot high.

The commonest species are *Aristida purpurea*, the PURPLE NEEDLE GRASS—which isn't always purple, notwithstanding its name—and the ARIZONA NEEDLE GRASS (*Aristida arizonica*). Both of these form close tussocks from six to ten inches in diameter with numerous narrow tough leaves six to eight inches high with many erect, stiff, slender stems and strict panicles of rather numerous spikelets. The awns are from an inch to an inch and a half long, sometimes quite purple but mostly greenish or yellow if old. They differ from each other in the size and shape of the empty glumes surrounding the "seed," as is described in the treatment of the genus which follows. There are several other species more or less common all of which closely resemble each other, and are hard to tell apart.

22. ARISTIDA L.

Plants annual.

Plants perennial.

Stems and branches of the panicle widely spreading, straight and rigid.

Awns 3, all about the same length.

Awns apparently 1, the lateral ones very short or wanting.

Stems and panicles erect, or at most weakly spreading.

Empty glumes nearly the same length.

Plant stout and strict, a foot high or more, with short, straight pedicels; empty glumes conspicuously awned.

Plant low and rather spreading, 10 inches high or less, with slender though stiff pedicels; empty glumes acuminate but not awned.

Empty glumes very unequal in the length, the lower one only about 1-2 as long as the upper.

Mature flowering glume not tapering upward, the neck about the same diameter as the base; second empty glume considerably longer than the flowering glume; the latter smooth; awns very long, often 3 inches or more

Mature flowering glume tapering upwards into a slender neck; second empty glume barely surpassing the flowering or usually shorter, the latter scabrous; awns less than 2 inches long usually (sometimes longer).

Spikelets small, 10 mm. long or less, the awns never more than twice as long, usually numerous.

Panicle strict, many flowered, and crowded, never spreading.

Panicle spreading at least at maturity.

Pedicels weak and sinuous; awns merely spreading; panicle spreading from the first.

Pedicels rigid, straight, ascending; awns divergent at right angles to the flowering glume; panicle at first congested, opening at last.

Spikelets larger, 15 mm. long or more; the awns usually more than twice as long as the flowering glume.

Panicle simple or nearly so.

Panicle strict; spikelets numerous and crowded, relatively small; pedicels short, erect.

Panicle more lax; the pedicels longer; spikelets few, scattered, 15 mm. long.

Panicle compound, with numerous large spikelets.

Stems stout; panicle rigidly erect; pedicels straight.

1. *A. Bromoides*.

2. *A. divaricata*.

3. *A. schiediana*.

4. *A. Arizonica*.

5. *A. havardii*.

6. *A. longisetia*.

7. *A. vaseyi*.

8. *A. micrantha*.

9. *A. — n. sp.*

7. *A. vaseyi*.

10. *A. fendleriana*.

11. *A. wrightii*.

Stems more slender and weaker;
 panicle laxly spreading; pedicels
 very slender and often
 curved.

12. *A. purpurea*.

1. ***Aristida Bromoides*** H. B. K. A common "six weeks" grass on the mesas and to some extent in the fields after the summer rains, in the southern part of the State, in the Lower Sonoran Zone.

2. ***Aristida divaricata*** Humb. and Bonpl. A fairly common widely branching needle grass in the sand hills and mesas in the the southern part of the State, sometimes in the drier foothills; in the Sonoran Zones.

3. ***Aristida schiediana*** Trin. and Rupr. Usually found along with the preceding species, which it closely resembles, except for the difference in the awns.

4. ***Aristida arizonica*** Vasey. One of the largest of the "needle grasses," coming into the west side of the State from Arizona. In the Sonoran Zones.

5. ***Aristida havardii*** Vasey. In the foothills and on the mesas of the southern part of the State, in the Sonoran Zones. A low spreading grass 6 to 10 inches high.

6. ***Aristida longiseta*** Steud. The LONG-AWNED NEEDLE-GRASS is the most easily recognized of all. It forms a close tuft with erect slender stems from a bunch of curling leaves: the awns are often 3 inches long or more and purplish tinged. On the plains and mesas throughout the State below the yellow pine zone.

7. ***Aristida vaseyi*** Woot. and Stand. In the rocky foothills of the low mountains on the mesas of the southern part of the State; in the Lower Sonoran Zone.

8. ***Aristida micrantha*** (Vasey) Nash. A western Texas species which comes into the southeastern corner of the State. Lower Sonoran Zone.

9. ***Aristida* n. sp.** So far known only from the southern part of the State on Tortugas Mountain near the Agricultural College. Lower Sonoran Zone.



TOBOSA GRASS. (*Hilaria mutica*.)

(Reprinted from The Grazing Ranges of Arizona, by J. J. Thornber;
Bull. 65, Arizona Agr. Exp. Station.)



TEXAS CURLY MESQUITE GRASS. (*Hilaria cenchroides*.)

(Reprinted from The Grazing Ranges of Arizona, by J. J. Thornber;
Bull. 65. Arizona Agr. Exp. Station.)

10. *Aristida fendleriana* Steud. A small, few-flowered "needle grass" from the mesas and foothills at elevations of from about 5500 feet to 7000 feet in the middle and northern part of the State. Upper Sonoran Zone.

11. *Aristida wrightii* Nash. A stiff coarse grass 18 inches high or more somewhat resembling the "Arizona needle grass" but the glumes are quite different. It occurs in the southern part of the State in the Sonoran Zones.

12. *Aristida purpurea* Nutt. The PURPLE NEEDLE GRASS, perhaps the commonest throughout the State but often not purple at all. It occurs on the mesas and plains and in the foothills at elevations of from 3500 feet to 6500 feet above sea level.

The Porcupine Grasses belonging in the genus *Stipa* are an interesting and somewhat varied group and several of them are of more or less importance. They may be recognized by the single beard or awn attached to the indurated single-seeded spikelet. This awn is generally rather conspicuous by its length, sometimes long and feathery, but it is always twisted just above the "seed" and bent more or less, in a direction at right angles to the "seed." The seed is tipped at the base with a very sharp pointed hairy callous which, taken with the peculiar awn habit of twisting and untwisting as affected by moisture, is no doubt in some way connected with the distribution and planting of the seed.

The NEW MEXICAN STIPA (*S. neo-mexicana*) has a long plumose awn about 2 inches long and *S. comata* is much like it except that the awn is not feathery. Both these grasses are rather large and moderately coarse perennial bunch grasses producing tufts 6 to 8 inches in diameter, of slender tough leaves, quite early in the spring or even in the late winter. The leaves are from 8 inches to a foot long and numerous in the tuft and the panicles when they appear are about two feet high. These grasses occur on the sand hills and plains in the northern part of the State and to some extent

in the mountains throughout the State, *S. comata* being fairly abundant in the region north and east of Santa Rosa.

They are relished by stock and considered very good feed by stockmen: they are of especial importance because they appear at a time when most of the other grasses are dead and dry. Apparently they do not reproduce readily and since they are now rarely allowed to go to seed, they are probably being gradually exterminated wherever stock can get at them. They grow in such situations as the Needle Grasses (to which they are closely related) and it would be wise to encourage the growth of the *Stipas* instead of the *Aristidas* if it were possible.

Three or four other species of this genus (*S. fimbriata*, *S. editorum*, and *S. pringlei*) furnish good feed wherever they occur in the mountains, but they are never very abundant any place and like those previously mentioned they are so palatable that they rarely are allowed to mature seed on the open range. They are slenderer and smaller grasses than the species already referred to, the awns are shorter and the plants mostly smaller. As separate tufts sparingly scattered in among the rocks or sometimes more or less protected by stiff or spiny shrubs they manage to escape their animal foes. They are summer grasses probably living only a few seasons; they may be recognized by their more slender habit, shorter awns and relatively rounder "seed." *Stipa fimbriata* is known as PINON GRASS in the Guadalupe Mountains, probably because it grows freely under the pinon trees.

Stipa vaseyi and *Stipa viridula* are two very similar species of coarse bright green grasses forming thick bunches and frequently covering considerable areas in the open gently sloping canons or park-like draws in the timbered mountains. They have leaves often 18 inches or more long and the crowded panicle is often as much as 4 feet high; the flowering and empty glumes as well as the leaves and stalks are all a uniform bright green and at first sight it would seem to be a

valuable grass. In the Sacramento Mountains *Stipa vaseyi* is known as SLEEPY GRASS and is reported upon good authority to act as a narcotic upon animals that eat it, especially affecting horses. The degree of narcotism depends upon the amount of the grass the animal eats, and, if stories current in that region are to be believed, may range from a general dullness through a period of profound sleep from which the animal cannot be aroused, sometimes lasting as much as 48 hours, to a comatose condition ending in death. Animals living in the region never eat the grass and an animal once affected shuns the plant. We have never had any experience with the grass which would in any way corroborate the above statements, but can vouch for the honesty of a number of men who have told in detail of their own personal experiences. One of us has so thoroughly believed their statements that on numerous occasions he has been careful to prevent his own horses from eating it. The grass never shows the effects of grazing wherever examined, though horses not accustomed to it will eat it freely. On two or three occasions one of us has been instrumental in obtaining the grass in quantity for chemical analysis, but such analyses of the dried grass have always given no information as to the cause of the narcotism. On one occasion his horses ate about fifty pounds of the dried grass without any noticeable effect. Whether the result was due to the failure to get enough of it or to a change in the grass due to drying or to the possible mythical character of the narcotism, it was impossible to say, and he has never been so situated as to be able to carry out a set of experiments with animals to get exact data on the subject. If it could be demonstrated that the dried grass is harmless and palatable to stock, it would pay to cut it in certain places where the stand is good. The amount of forage produced upon an acre would probably be rather heavy, since the grass is large and leafy and stems stout. It is possible that two cuttings might be obtained. A crop would thus be obtained from land that now yields nothing. The belief in its narcotic effects is general through-

out the Sacramento Mountain region where the grass is fairly common at elevations of 6500 feet or more in the bottoms of the open mountain canons where the soil is tolerably wet. Where the range has been heavily stocked with cattle the grass has spread pretty rapidly as the result of killing out the other grasses which successfully compete with it for place. *Stipa vaseyi* occurs in the mountains of the northern part of the State in and around Las Vegas, at Taos and near Chama but repeated inquiries in these regions were never rewarded with any knowledge of any plant called Sleepy Grass. The grass is not eaten by stock in that region any more than farther south, but at Taos some of the Mexican women gather it and tie it into bundles of convenient size and use them as whisk brooms for cleaning the hearth and about the house. The absence of any reports of Sleepy Grass in this region made the authors doubt the correctness of their field determinations of the species, but comparisons of the grass of the northern mountains with that of the Sacramento Mountains demonstrated their identity.

Stipa viridula is very like *S. vaseyi* and from the standpoint of the stockman would not be recognized as separate. It ranges farther north being the more common of the two in Colorado. *Stipa minor* and *Stipa scribneri* have somewhat the same aspect but are smaller and by no means so common. They are probably eaten by stock wherever they occur. The last four species named all have rather short and inconspicuous awns, rarely over half an inch long, but they are twisted and somewhat bent as in the other species listed. Following is a list of the 10 species that occur in the State with their distribution. Number 3, *Stipa tenuissima* is very rare and is botanically quite interesting since it lacks the character which is most peculiar of all Stipas. The awn is not twisted above the seed but is bent and curled above the bend. It is a bunch grass about 18 or 20 inches high forming a large dense tuft, the leaves being as tall as the panicle of very long-awned spikelets.

23. STIPA L. PORCUPINE GRASS.

Empty glumes of the spikelet 20 mm. long or more, awns long.

Awns plumose or feathery.

Awns not plumose.

Empty glumes of the spikelet less than 15 mm. long.

Panicle loose and open.

Flowering glumes small, 4 mm. long or less.

Awn long, 2 to 3 inches, curled above the bend; flowering glume about 3 mm. long.

Awn short, about half an inch long, not curled; flowering glume about 4 mm. long.

Flowering glumes larger, 6-mm. long.

Empty glumes narrow; awns about two inches long, somewhat curved.

Empty glumes broad; awns an inch long or less.

Panicle narrow and dense, spike-like.

Leaf blades narrow, margin rolled in; plants slender; spikelets rather few.

Flowering glumes 4 to 5 mm. long.

Flowering glumes 8 to 10 mm. long.

Leaf blades broad, not inrolled; plants stout; spikelets numerous and crowded in large panicles.

Plants tall, 3 feet or more; spikes 8 inches to a foot long.

Plants lower, about 2 feet high; spikes about 6 inches long.

1. *S. neomexicana*.

2. *S. comata*.

3. *S. tenuissima*.

4. *S. fimbriata*.

5. *S. editorum*.

6. *S. princei*.

7. *S. minor*.

8. *S. scribneri*.

9. *S. vaseyi*.

10. *S. viridula*.

1. *Stipa neo-mexicana* (Thurb.) Scribn. On sandy mesas and to some extent in the mountains almost all over the State; never anywhere abundant: in the Upper Sonoran Zone.

2. *Stipa comata* Trin. and Rupr. In similar locations to the preceding ranging a little higher and more abundant in the northeastern part of the State; in the Upper Sonoran and Transition Zones.

3. *Stipa tenuissima* Trin. A rare grass found at lower levels in the southern part of the State in the Sonoran Zones.

4. *Stipa fimbriata* H. B. K. In the mountains of the southern part of the State: in the Upper Sonoran Zone. Called PINON GRASS in the Guadalupe Mountain region, because it frequently grows under the pinon trees.

5. *Stipa editorum* Fourn. Occurs with the preceding species in the mountains of the southern part of the State; in the Upper Sonoran Zone.

6. *Stipa pringlei* Scribn. Known in New Mexico only from the Mogollon Mountain region.

7. *Stipa minor* (Vasey) Scribn. Occurs in the mountains in the northern part of the State; in the Transition Zone.

8. *Stipa scribneri* Vasey. In the mountains at middle elevations; not common. In the Transition Zone.

9. *Stipa vaseyi* Scribn. Called SLEEPY GRASS in the Sacramento and White Mountain region. Occurs in the mountains of the northern and southeastern part of the State. Not known from the Mogollon Mountain area. In the Transition Zone.

10. *Stipa viridula* Trin. Extending into New Mexico from the north. Fairly common in the mountains of the northern end of the State above middle elevations: in the Transition Zone.

The immediate relatives of the Porcupine grasses are three species which have much the same general appearance but may be distinguished from them by the fact that the awn is not twisted and breaks away from the "seed" when the latter is ripe. Two of these are worthy of mention because they occur rather widely scattered over the State and are hence apt to be noticed by the observer and also because they add a little to the forage crop, though not very much.

The larger, *Eriocoma cuspidata*, (it has no common name so far as we have been able to learn) is a spreading bunch grass about 12 to 15 inches high, with widely spreading panicles bearing nearly round "seeds" enveloped in a tuft of silky hairs and having a short, untwisted awn. It usually occurs on sand hills and would make a pretty good sand-binder, since its roots are long and strong and penetrate deeply. It is a long-lived perennial and seems very well fitted to live on the sandy dunes where so few other things can live.

The other species is one of the rice-like grasses

(*Oryzopsis micrantha*) and resembles the preceding pretty closely, but is much smaller and more delicate and the "seed" is not silky. It seems to prefer a rather shaded location and is often seen growing among rocks in the mountains. It is never very abundant in any location but is apt to be met in the lower parts of the mountains almost any place in the State. It is relished by stock and adds its small contribution to the forage crop. The other species of this genus is rare in the mountains, and of little importance.

24. *ERIOCOMA* Nutt.

Eriocoma cuspidata Nutt. Occurs on sandy soils at the lower levels throughout the State in the Sonoran Zones.

25. *ORYZOPSIS* Michx.

Leaves slender and inrolled from the edges;
spikelet small, 2-4 mm. long.

1. *O. micrantha*.

Leaves broader, often flat; spikelets 6-8 mm.
long.

2. *O. asperifolia*.

1. *Oryzopsis micrantha* (Trin and Rupr.) Occurs in the lower mountains under piñon trees or among rocks, in the Upper Sonoran Zone, ranging upward.

2. *Oryzopsis asperifolia* Michx. A rare grass found in the mountains at middle elevations in the Transition Zone.



Muhlenbergia mexicana



MESQUITE GRASS. (*Muhlenbergia porteri*.)



Muhlenbergia gracillima.



TEXAN TIMOTHY. (*Lycurus phleoides*.)

The Muhlenbergias. We now come to the largest genus of grasses, when considered from the standpoint of number of different species, to be found represented in the flora of New Mexico. Notwithstanding the fact that they are numerous, varied, common throughout the State in one form or another, and more or less useful, they have no common name, hence it is necessary to use the botanical one. One species is known as Mesquite Grass probably because of its habit of seeming to hide under the spiny protection of the mesquite bushes, but this name is a poor one and is never applied to any of the other species. Another species is sometimes called Aparejo Grass on account of its use, but this is not typical of the group either.

It may be of interest, for the sake of the association of ideas, to know that the genus is named in honor of a German botanist by the name of Muhlenberg, who lived in Pennsylvania in the early part of the last century and was much interested in the study of grasses of North America.

The genus is characterized by having small single-flowered spikelets on the ends of the smallest of the stem divisions and the two inner (flowering) glumes are more or less hardened and closely and permanently enclose the seed. In some of the species one of the flowering glumes is tipped by a slender straight awn that may be either quite short or two or three times the length of the spikelet, while in still other species the awn is lacking. There is also considerable diversity in the form of the panicle, there being all variations from a strict compact spike to a widely branched and spreading panicle with long hair-like branches.

Two of the species are coarse grasses usually about three feet high forming large leafy tufts with stout culms and large panicles bearing many spikelets. The leaves are often eighteen inches or more long and rough and tough, and the panicles are spreading and a light purple color. They (Nos. 1 and 2 in the list of species following) are fairly common in the mountains of the southern part of the state among the

rocks and on cliff faces, but are of little economic importance since stock of any kind rarely gets to them or eats them. They have a small value as decorative plants to be grown where the supply of water is so limited that better species requiring more water cannot be cultivated. Another species of this kind but smaller and with a widely-spreading panicle of dark purple spikelets is number 21 of the list. It is rare in the southwestern part of the State.

Numbers 4, 5, 6, 7, and 8 have more or less of the same aspect, and are to be separated by the more minute characters indicated in the key. Their panicles are usually strict and the green or blackish spikelets are crowded close together forming a dense or sometimes interrupted spike. The stems are mostly jointed and leafy, so the plants usually produce some considerable forage which is succulent and is eaten freely by stock in the summer time when it is green. They are not anywhere very abundant and therefore of no great economic importance.

APAREJO GRASS (*Muhlenbergia utilis*) is a low species forming a rather thick sod in favorable situations. It receives its common name because it is used to stuff the pads (*aparejos*) used in certain parts of Mexico in lieu of pack saddles. It is rather common in the southern part of the State in the irrigated valleys, sometimes in alfalfa fields, often by the roadside, and is sometimes somewhat of a pest, though probably not very difficult to eradicate. It is able to hold its own against alfalfa if once established and will probably crowd the latter out. It has a little value as a pasture grass but is not very much liked by stock, though they will eat it if nothing else is easily available.

Numbers 12, 14, and 15 are fairly common tufted grasses growing at middle elevations in the timbered mountains. Number 13 is closely related to them though much rarer in the State. All of them are of medium size from 12 to 18 inches high with rather large panicles of many small spikelets. They are evidently palatable, since they are freely eaten by all kinds of stock wherever they occur.

As widely distributed a species of the genus as any, and certainly as much named as any (it has been named three times by different authors) is *Muhlenbergia monticola* Buckley, which grows in the dry rocky canons or on ledges of cliffs in the mountains. It is a wiry grass forming tufts four or five inches in diameter of slender tough culms and numerous, very narrow leaves. The panicle is strict though the pedicels are of some length and the awns tipping the small light purlish spikelets are half an inch or more long. It is more often referred to in the books as *Muhlenbergia neomexicana* Vasey, but the name given above was the first tenable one given it and must therefore be used. While widely scattered and relatively common, appearing as it probably does in practically every mountain range in the State, it is nevertheless of small economic importance. The author has rarely seen specimens of the species showing the effects of cropping or grazing of any kind, and has been led to believe that stock do not care for it to amount to anything.

MESQUITE GRASS (*Muhlenbergia porteri*, also improperly called *M. texana* in some of the books) is a common grass in the southern part of the State where it is to be found on the mesas growing in the protection of the mesquite bushes or other thorny shrubs. It is a much branched and leafy plant, often forming a mass of stems and leaves 18 inches to 2 feet in diameter, the lower parts of the slender stems resting on the ground. The stems are at least partly perennial and in the spring it is not uncommon to find the new growth coming on the lower parts of the stems of the previous year that have wintered over. Stock like the grass very much and search for it among the bushes. In this way it is being gradually exterminated (as is the case with other first class forage plants of the open range) and is rarely found out of the protection of some spiny shrub. It is extremely drought resistant, and grows where many other grasses cannot. Cultivation experiments with this species have not yet been carried on, but it is doubtful whether or not it propagates much from seed.

Muhlenbergia pungens, so called because its leaves are stiff and spiny pointed is to be found growing on the sand hills at various places in the State and would no doubt make a fine sand-binder. It has stout scaly underground stems, running in various directions, which would make the work of propagating it easier than with the seed. The panicle is at first pretty close but later it spreads considerably, and is a beautiful reddish purple color. Notwithstanding its very sharp pointed and tough leaves, cattle seem to like it and eat it freely, probably because of some agreeable taste. Unfortunately for the stockman's interests it is not at all common and nowhere abundant in the State.

Muhlenbergia gracillima is perhaps as common as any of the species of the genus that occur in the state. It usually is fairly abundant any place where ordinary Grama occurs, commonly on the higher mesas and plains, and on the lower parts of the mountains where the timber is entirely absent or very widely scattered. It may be recognized by its peculiar habit of growth. It is always a small grass forming circular or lobed "bunches" which grow on the outside, ever increasing the size of the tuft, but die in the middle, thus forming more or less circular rings of vegetation with a bare spot in the middle. The panicle is usually 6 to 10 inches high, widely spreading, with many very small purple spikelets on numerous very fine branches. The leaves are always very short (1 or 2 inches long) and recurved even on the growing plant, but much more so on the dried material. The grass is eaten somewhat by stock but is not well liked, possibly because it pulls up freely bringing up sand and dirt which they do not like in their mouths. It is not of any large importance of itself, but its presence in anything like abundance on a range indicates that that range is beginning to succumb to the effects of overstocking. The grass in question can not compete successfully with ordinary Grama, hence when it is a prominent grass in a range containing Grama it shows that the Grama has been crowded out and the *Muhlenbergia* is being given an

advantage in its contest for a place; otherwise it would not be there and a much more valuable grass would be the prevailing one.

Muhlenbergia arenicola is similar to the last in the appearance of the panicle but it is usually a larger plant, often 12 to 15 inches high, and its leaves are longer and not recurved. It also has a different habitat, being common at lower levels on the sandy soils of the southern, especially the southeastern part of the State, where it is an unimportant member of the grass flora.

26. MUHLENBERGIA Schreb.

Plant stout, 3 feet high or more; panicles from 10 inches to over 1 foot long, with very numerous spikelets.

Spikelets with a long awn.

1. *M. vaseyana*.

Spikelets without any awns.

2. *M. distichophylla*.

Plants lower, 2 feet high or less, more slender, the panicle always shorter.

Panicle narrow and spike-like.

Low annual, 3 to 6 inches high.

3. *M. schaffneri*.

Plants perennial, mostly larger but some species low.

Empty glumes awl-shaped; leafy branched plants with long rootstocks covered with overlapping scales.

Empty glumes about as long as the flowering glumes, not awned.

4. *M. mexicana*.

Empty glumes longer than the flowering glumes, awned.

Flowering glumes slightly villous.

5. *M. racemosa*.

Flowering glumes long white villous.

6. *M. comata*.

Empty glumes broader, lanceolate to ovate.

Flowering glumes awnless or very short awned.

Empty glumes less than half as long as the flowering glumes.

7. *M. richardsonis*.

Empty glumes more than half as long as the flowering glumes.

Empty glumes awn-pointed, flowering glumes scabrous or smooth.

Panicle dense, obtuse, 5-10 mm. wide.

8. *M. wrightii*.

Panicle slender, lax, tapering at the apex, less than 5 mm wide.

9. *M. cuspidata*.

Empty glumes acute, not awn-pointed.

- Panicles on long peduncles. 10. *M. thurberi*.
 Panicles included in the leaf sheaths at the base. 11. *M. utilis*.
 Flowering glumes with long conspicuous awns.
 Leaf sheaths very broad at the base, thin and papery, loose, not closely surrounding the stems.
 Second empty glume 3-toothed; flowering glume pubescent at the top. 12. *M. gracilis*.
 Empty glumes both acute or acuminate; flowering glume pubescent only below. 13. *M. virescens*.
 Leaf sheaths not broad and papery, closely enclosing the stem. 14. *M. affinis*.
 Spikelets on long slender pedicels.
 Spikelets on short stout pedicels or without any.
 Awns about 5 mm. long; plant stout; internodes long. 15. *M. acuminata*.
 Awns about 20 mm. long; plant slender, wiry; internodes short. 16. *M. monticola*.
 Panicle open and spreading.
 Plant diffusely branched, weakly ascending or decumbent, culms perennial. 17. *M. porteri*.
 Secondary branches of the panicle clustered; leaves spiny-pointed and stiff.
 Secondary branches of the panicle single; leaves not spiny-pointed nor very stiff. 18. *M. pungens*.
 Basal leaves short, 2 inches long or less, strongly curved or arched. 19. *M. gracillima*.
 Basal leaves usually longer, not recurved.
 Awns short, 4 mm. long; leaf-blades 2 to 4 inches long; panicle green. 20. *M. arenicola*.
 Awns longer, 10 to 15 mm. long; leaf-blades about 8 inches long; panicle dark purple. 21. *M. berlandieri*.

1. *Muhlenbergia vaseyana* Scribn. In the drier mountains at the southern end of the State at elevations up to about 6000 feet in the Upper Sonoran Zone.

2. *Muhlenbergia distichophylla* (Presl.) Munro. Associated with the preceding species more or less.

3. *Muhlenbergia schaffaneri* Vasey. A small annual occurring around seeps in the mountains of the southern part of the State; in the Upper Sonoran Zone.

4. *Muhlenbergia Mexicana* (L.) Trin. A rather rare species in the mountains at elevations of 7000 feet or more: in the Transition Zone.

5. *Muhlenbergia racemosa* (Michx.) B. S. P. Rather common in the mountains at middle elevations: in the Transition Zone and downward into the Upper Sonoran. It superficially resembles the preceding as well as the next more or less.

6. *Muhlenbergia comata* (Thurb.) Benth. Known from a single locality in the mountains on the headwaters of the Pecos. It probably is more abundant but this is the only recorded collection in New Mexico. A more northern species.

7. *Muhlenbergia richardsonis* (Trin.) Rydb. In the mountains of the more northerly part of the State: in the Transition Zone.

8. *Muhlenbergia wrightii* Vasey. In the mountains at middle elevations: in the Transition Zone.

9. *Muhlenbergia cuspidata* (Torr.) Rydb. In the mountains at middle elevations: in the Upper Sonoran and Transition Zones.

10. *Muhlenbergia thurberi* Rydb. The type locality is on the plains in the eastern part of the State at Plaza Larga. Only certainly known in New Mexico from this collection.

11. *Muhlenbergia utilis* (Torr.) Rydb. APAREJO GRASS. At the lower levels in the southern part of the State; in the Sonoran Zones.

12. *Muhlenbergia gracilis* Trin. In the mountains at middle elevations; in the Transition Zone.

13. *Muhlenbergia virescens* (H. B. K.) Trin. Known in New Mexico from two collection from the mountains of the western part of the State; in the Transition Zone.

14. *Muhlenbergia affinis* Trin. In the drier mountains of the southwestern part of the State: in the Upper Sonoran Zone.

15. *Muhlenbergia acuminata* Vasey. With the preceding; in the Upper Sonoran Zone, in the southwestern part of the State.

16. *Muhlenbergia monticola* Buckl. In the drier parts of the mountains almost throughout the State. Mostly in the Upper Sonoran Zone.

17. *Muhlenbergia porteri* Scribn. MESQUITE GRASS—not Vine Mesquite nor Texas Mesquite. On the mesas and low mountains of the southern part of the State; in the Lower Sonoran Zone.

18. *Muhlenbergia pungens* Thurb. On sand dunes at various places throughout the State, in the Sonoran Zones.

19. *Muhlenbergia gracillima* Torr. On the higher plains or in the mountains at the southern end of the State; in the Upper Sonoran or sometimes low down in the Transition Zone.

20. *Muhlenbergia arenicola* Buckl. On sandy soils in the southern part of the State; in the Sonoran Zones.

21. *Muhlenbergia berlandieri* Trin. Known only from a single collection in the southwestern corner of the State.



ALPINE TIMOTHY. (*Phleum alpinum*.)



BUNCH GRASS. SALT GRASS. (*Sporobolus airoides*.)

Texan Timothy (*Lycurus phleoides*) is a common and rather important grass which is found occasionally on the upper plains but more often on the hillsides on dry soils or on the rockier mountain sides almost throughout the State where it forms an important part of the forage of such localities. It is usually associated with Tall Grama and although it never forms a sod it occupies much of such areas forming the typical "bunches" of the species. The panicle is a slender, crowded, cylindrical spike somewhat resembling that of Timothy, (whence its name) but somewhat more hairy in general appearance and not quite as large. The plant itself is generally from a foot to 16 inches tall, stools considerably; the leaves are short and the whole plant is a dull grayish color. Stock eat it fairly well.

Timothy (*Phleum pratense*) hardly needs to be referred to here since most of our farmers and stockmen know its merits very well although but few of them seem to have tried to grow it. Almost wherever it has been tried it has escaped from cultivation and it grows wild in a number of places in the cooler wet meadows in the mountains or beside ditches from small mountain streams. It does not grow well in the lower hotter valleys even under irrigation but in localities where oats do well and where alfalfa is not a satisfactory crop, timothy should probably be used much more than it now is.

ALPINE TIMOTHY (*Phleum alpinum*) is a rather common plant in high mountain meadows where the soil is very wet and the climate cool. It is only important as a small part of the summer forage or the hay crop of such localities. It also occurs on the higher peaks near and above timber-line, where it matures in the short season of such situations, but is of little economic importance.

27. **LYCURUS** H. B. K.

1. **Lycurus phleoides** H. B. K. TEXAN TIMOTHY. Common all over the State in the Upper Sonoran Zone extending both downward and upward into the Lower Sonoran and the Transition Zones.

28. **PHLEUM** L.

Spikes elongated-cylindric: awns less than one half as long as the outer glumes.

1. *P. pratense*.

Spikes short and ovoid or oblong: awns about one half as long as the outer glumes.

2. *P. alpinum*.

1. **Phleum pratense** L. TIMOTHY. An introduced species which has become naturalized in a few places along ditches in the mountains in the Transition Zone.

2. **Phleum alpinum** L. ALPINE TIMOTHY. In high mountain meadows and on cold ridges and exposed peaks in the Hudsonian and Arctic-alpine Zones.

29. **ALOPECURUS** L.

1. **Alopecurus fulvus** Smith. A not uncommon grass found growing in wet places in the Transition Zones. It is sometimes called "water grass" but this is purely a local name.

Alopecurus agrestis L. has been introduced as a weed in a few places, the seeds having come with garden or field seeds.

The Dropseed Grasses (*Sporobolus* spp.). This genus of grasses, represented in New Mexico by twelve species, is one of the most important of the grass genera of the lower levels. With the exception of *Sporobolus confusus*, a small annual species usually found in rocky cliffs beside seeps in the mountains, all of the New Mexico species of the genus occur on the sandy mesas and open plains of the southern part of the State. **BUNCH GRASS** (*Sporobolus airoides*) or Salt Grass, as they call it in the southeastern part of the State, is an important range and pasture grass. It is often quite abundant in the lower flats especially where the soil is alkaline. For while it is not always restricted to alkaline soils it will endure a large amount of alkali in the soil and usually lives where the soil is just a little moist, a condition which is often common in alkaline or "gyp" soils, probably due to the ability of such soils to retain moisture. In a number of the lower open plains this grass is very abundant. It also is fenced in at certain places and used as a pasture grass. Under the latter conditions wherever it gets a fair amount of water it makes pretty good summer feed. It appears to be palatable to horses and cattle only when it is fresh and green in the summer after the rains, and they eat it rather sparingly at best. It is said to be detrimental to sheep at certain stages in its development, causing them to bloat. It also occurs rather sparingly in the sandy soils of the lower valleys on the waste lands not yet in cultivation and it was doubtless formerly one of the very commonest of the grasses of these localities until they were put under irrigation. It not infrequently occurs as a roadside or fence-row weed in cultivated lands. It is a rather coarse grass with numerous green rather stiff leaves and widely branching and spreading panicles of small 1-flowered spikelets; the leaves are often 2 feet long and the panicle 2 to 2 1-2 feet high. The stems are numerous and clustered, forming a big "bunch" often a foot in diameter at the base, thus giving rise to this use of that name.

SACATON (*Sporobolus wrightii*) is another important

member of this genus and one that has been used rather extensively at certain places. It is more exacting as to the amount of water it requires than is *S. airoides*, nor will it endure so much alkali in the soil. In certain places not far from Silver City it grows rather abundantly in a narrow arroyo and it has been cut here and at other places in that region as hay grass. Liverymen prefer it as a hay to alfalfa for buggy horses that are rented out for hard service. It is a coarse grass often 5 feet high or more with a spreading panicle bearing very numerous single spikelets. If cut at the proper time and thoroughly cured it makes a coarse but palatable hay that horses soon learn to eat and seem to relish. It might easily be raised on irrigated lands but it could hardly compete with alfalfa as a hay crop hence it has not been used for this purpose except in restricted localities where alfalfa could not be grown and where the water supply is in the nature of flood water and very uncertain in quantity. This grass might be encouraged by a little effort and would no doubt respond to such efforts. It produces abundance of seed which live for a long time if kept in a dry place, and germinate readily during the summer months if supplied with a little water. Once established the grass can withstand considerable dry weather. *Sporobolus cryptandrus*, *S. strictus*, *S. flexuosus*, and *S. giganteus* occur mostly as scattered plants on the sandy drifting soils of the mesas and valleys where they are long or short lived perennials and act naturally to some extent as sand-binders. They might easily be encouraged in this for they produce considerable seed that germinates rather readily. On such sandy lands that are enclosed and not subject to grazing these grasses and the Needle grasses usually become more abundant and materially assist in holding the water that falls. On the open range they are apt to be eaten out because stock like them. But for their ability to reproduce by seed and the vitality and abundance of seed produced they would probably be well killed out on the open range.

NEALLY'S DROPSEED GRASS (*Sporobolus nealleyi*) is of

importance in one particular; it never occurs on anything but "gyp" soils. It is one of the few grasses that are adapted to such locations and while it is a very poor feed it is as good as the other plants that will grow on such soils and is valuable at all merely because it is a little better than nothing.

Sporobolus auriculatus and *S. asperifolius* are two species closely resembling each other, both being small low grasses with small panicles and slender, sometimes weak stems and rather numerous small leaves. The former is inclined to form sodded patches in low spots on the dry plains in common and alkaline soils. The latter is more common beside ditches or in the river valleys on the first flood plain above the river level. It also is quite alkali resistant. Neither is of much importance as a range or pasture grass.

30. SPOROBOLUS R. Br. DROP SEED GRASSES.

Panicle narrow, spike-like (See also No. 10)

Plant tall and robust; 3 to 4 feet high.

1. *S. giganteus*.

Plant lower and slenderer; generally about 2 ft. high.

2. *S. strictus*.

Panicle branching and more or less spreading.
Plant annual; 2 to 8 inches high.

3. *S. confusus*.

Plants perennial, of various sizes.

Plants with long scaly rootstocks; the empty glumes about equal.

Panicles about 3 inches long; stem rigid though slender; leaves short; spikelet slightly larger than in the next two.

4. *S. auriculatus*.

Panicles 5 to 8 inches long; stems weak often elongated; leaves longer; spikelet very small.

5. *S. asperifolius*.

Plants without long scaly rootstocks; empty glumes very unequal.

Sheaths naked, or sparingly ciliate at the throat.

Plant less than 3 feet high; panicle very open; empty glumes nerved.

7. *S. airoides*.

Plant from 4 to 6 feet high; panicle not so widely spread, with very many spikelets; empty glumes without nerves.

8. *S. Wrightii*.

Sheaths with a conspicuous tuft of hairs at the throat.

Sheaths pubescent; leaf blades widely spreading; panicles 3 inches long or less; plant not over 1 foot high and slender.

9. *S. Nealleyi*.

Sheaths almost or quite glabrous; leaf-blades not widely spreading; panicles 6 inches to more than 1 foot long; plant 2 feet high or more; stouter.

Panicle mostly included in the sheath, rarely if at all spreading, lower branches longer than the upper:

Flowering glumes about equal to empty glumes, acute or obtuse, less than 2 mm. long.

Flowering glumes much longer than the empty glumes, long acuminate 5 to 6 mm. long.

Panicle mostly exserted, rather widely spreading, sometimes somewhat nodding; lower branches about as long as the upper ones.

10. *S. cryptandrus*.

11. *S. asper*.

12. *S. flexuosus*.

1. **Sporobolus giganteus** Nash. A rather uncommon coarse grass of the sand hills in the southern part of the State, in the Lower Sonoran Zone.

2. **Sporobolus strictus** (Scribn.) Merrill. Common in the southern part of the State on the sandy mesas and reaching up into the drier mountains in the Lower and Upper Sonoran Zones.

3. **Sporobolus confusus** Vasey. Usually occurs beside seeps in the mountains in the Upper Sonoran and Transition Zones.

4. **Sporobolus auriculatus** Vasey. In the very driest situations on the Mesas; rather rare but easily confused with the next which is pretty common. Mostly Lower Sonoran.

5. **Sporobolus asperifolius** (Nees and Mey.) Thurb. Fairly common on ditch banks and beside streams, sometimes forming a sod on small areas; mostly in the Upper Sonoran Zone.

6. **Sporobolus texanus** Vasey. So far, known in New Mexico only from the Pecos Valley from Roswell south: in the Lower Sonoran Zone.

7. **Sporobolus airoides** Torr. BUNCH GRASS. Salt Grass (of the Pecos Valley region). One of the commonest grasses of the lower levels in the State: in the valleys and on mesas; in the Lower Sonoran Zone.

8. **Sporobolus wrightii** Scribn. SACATON. A much prized coarse perennial, growing beside arroyos and on the mesas where there is sufficient water, in the Lower Sonoran Zone.

9. **Sporobolus nealleyi** Vasey. A small and unimportant

grass found only on soils containing large quantities of gypsum in the southern part of the State in the Lower Sonoran Zone.

10. *Sporobolus cryptandrus* (Torr.) A. Gray. A common grass throughout the State in dry soils, mostly in the Upper Sonoran Zone, though extending into the lower Sonoran.

11. *Sporobolus asper* Michx. and Knuth. Collected once in the mountains of the northern part of the State in the Upper Sonoran Zone.

12. *Sporobolus flexuosus* (Thurb.) Rydb. Usually on sandy soils in the southern part of the State, mostly in the Lower Sonoran Zone.

Polypogon monspeliensis, sometimes called BEARD GRASS, superficially resembles a Foxtail or Squirrel-tail grass because of the compact panicle with numerous long awned spikelets. It is of no economic importance and occurs usually in wet alkaline spots at the lower levels. It is nearly always to be found beside any permanent water hole, boggy place or spring where the ground is trampled by the animals that come to drink.

Blepharoneuron tricholepis is a fairly common perennial grass growing in tufts among the rocks and on dry hillsides in the mountains at elevations of from 6000 to 8000 feet. It is a very persistent, long lived perennial and forms considerable of the forage in such localities though it never appears as anything but scattered bunches.

Epicampes rigens is a grass which superficially resembles *Sporobolus giganteus* and grows in similar situations, i. e. on the sand dunes of the lower plains. It is nowhere very common and consequently of little economic importance.

RED TOP and its relatives of the genus *Agrostis* occur rather sparingly in the mountains at rather high levels. RED-TOP (*Agrostis alba*) has been introduced in many places with grass seed for meadows and sod grass and in the cooler timbered regions has freely escaped and established itself on

the ditch banks and in wet natural meadows. *Agrostis hiemalis* is a native species of very slender grass a foot or so high with numerous erect stems forming tufts six inches in diameter and crowned by weak nodding panicles of small spikelets on very slender branches. The grass occurs only in the cool forests of the higher mountains, preferring a cool rich soil and some shade. It is unimportant except as it forms a small part of the summer pasture in such places. WATER BENT GRASS (*Agrostis stolonifera*) and the very similar species *A. asperifolia* occur only in boggy or wet places beside water holes, springs, creeks or along ditch banks. They are of no importance economically.

Two species of *Calamagrostis* come into the State from the north being found in the cool forests of the high mountain peaks of the northern part of the State, where they are moderately common and add somewhat to the crop of summer forage.

31. POLYPOGON Desf. BEARD GRASS.

Awns very long, concealing the spikelets.
Awns shorter, not concealing the spikelets.

1. *P. monspeliensis*.
2. *P. littoralis*.

1. **Polypogon monspeliensis** (L.) Desf. In wet soil beside streams, ditches or springs in the Sonoran Zones, mostly the Lower Sonoran.

2. **Polypogon littoralis** (With.) Smith. Very similar to the last and associated with it.

32 CINNA L.

1. **Cinna latifolia** (Trev.) Griseb. Has been collected once in the Sandia Mountains where the seed was probably introduced with garden seed. Normally lives in cold damp woods in the extreme eastern and northeastern part of North America.

33. BLEPHARONEURON Nash.

1. *Blepharoneuron tricholepsis* (Torr.) Nash. Common in dry rocky cliffs or hills in the Transition Zone almost throughout the State.

34. EPICAMPES Presl.

1. *Epicampes rigens* Benth. A single species of a genus common in Mexico; found only in the southern part of the State, mostly in the southwest corner in the Sonoran Zones.

35. AGROSTIS L. RED-TOP

Panicle very dense or very narrow, the branches of the panicle short and mostly concealed by the spikelets.

Stems weak at the base, bending down and rooting; panicle short and thick.

Stems erect, not creeping over the ground; panicles large, very dense, bright green.

Panicle loose and spreading, the branches easily seen, spikelets not crowded.

Branches of the panicle 3 to 4 inches long, very slender and weak.

Branches of the panicle about 2 inches long, stouter and more rigid.

Palet very minute; a rare, high mountain species.

Palet half as long as the flowering glume; the common "redtop."

1. *A. stolonifera*.

2. *A. asperifolia*.

3. *A. hiemalis*.

4. *A. idahoensis*.

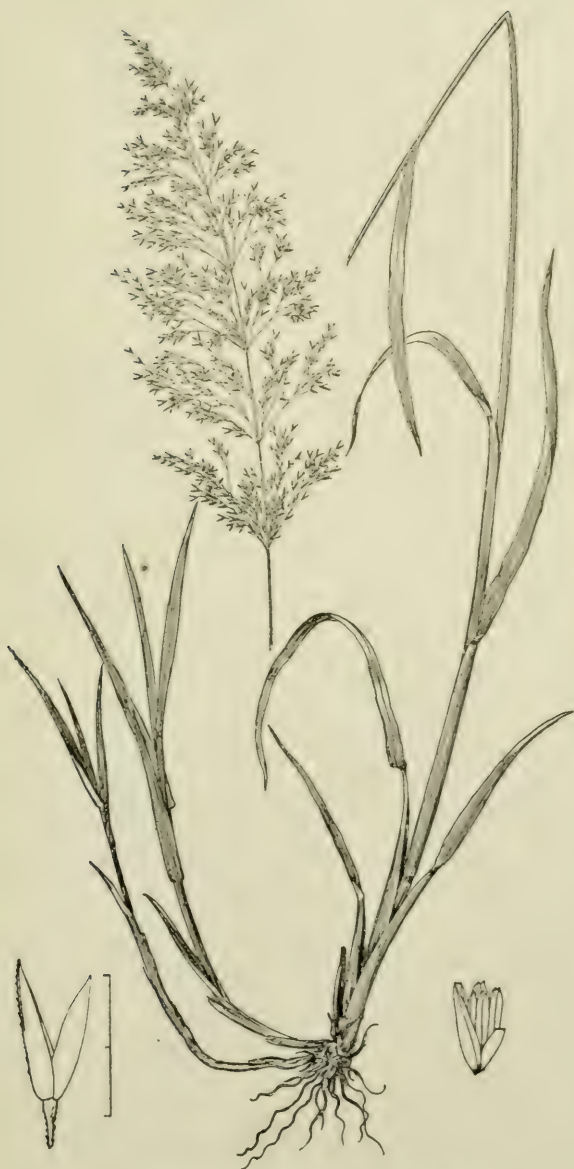
5. *A. alba*.

1. *Agrostis stolonifera* L. In the southern part of the State in the Lower Sonoran Zone.

2. *Agrostis asperifolia* Trin. Beside running water in the Transition Zone. A few records from the ditch banks of the lower irrigated valleys.

3. *Agrostis hiemalis* (Walt.) B. S. P. In the higher and cooler mountains, in rich soil and frequently in shade; mostly in the Canadian Zone though coming down into the Transition Zone.

4. *Agrostis idahoensis* Nash. Similar to the last but stiff and erect; rare in the mountains of the northern part of the State in the Canadian Zone.



RED-TOP. (*Agrostis alba.*)

5. *Agrostis alba* L. RED-TOP. This grass grows well in the higher mountains at elevations of more than 7000 feet in wet soils. It has been introduced at various places and escaped, so it is now found in higher wet meadows and beside streams in the Transition Zone and higher. Variety *vulgaris* is a form with a more spreading panicle.

Agrostis rosei Hitchc. is a rare species collected but once in the extreme southwestern corner of the State at Cloverdale.

36. CALAMAGROSTIS Adans.

Panicle open, the lower branches wide spreading, often drooping; leaf blades flat; callus hairs copious, almost equaling the glume.

1. *C. canadensis*.

Panicle more contracted, lower branches not drooping; leaf blades involute; plant with many stems in a cluster.

2. *C. hyperborea americana*.

1. *Calamagrostis canadensis* (Michx.) Beauv. Found only in the high mountains at the northern end of the State in the Transition Zone.

2. *Calamagrostis hyperborea americana* (Vasey) Kearney. Known in New Mexico from a single locality in the mountains at the northern end, in the Canadian Zone.

37. CALAMOVILFA Hack.

1. *Calamovilfa gigantea* (Nutt.) Scribn. and Merrill. A single New Mexico specimen without definite locality is in the National Herbarium but it is reported from New Mexico in the original description.

2. *Calamovilfa longifolia* (Hook.) Hack. This plant also has only been collected once on the very boundary of the State in the northeast corner.



BULBOUS PANIC GRASS. (*Panicum Bulbosum*.)

(Reprinted from The Grazing Ranges of Arizona, by J. J. Thornber;
Bull. 65, Arizona Agr. Exp. Station.)



SACATON. (*Sporobolus Wrightii*.)

(Reprinted from *The Grazing Ranges of Arizona*, by J. J. Thorne; Bull. 65, Arizona Agr. Exp. Station.)

The Oats Grasses (Tribe VI AVENEAE), the tribe of grasses to which the cultivated Oats belong, is not well represented in New Mexico, there being but ten species so far collected in the State and one of these is an introduced weed. OATS (*Avena sativa*) is cultivated to considerable extent at various places in the higher mountains in the cooler open valleys or parks where a small amount of irrigation water is available or where the summer rains are sufficiently abundant to mature a crop. WILD OATS* (*Avena fatua*) has been introduced in a number of places as a weed in grain fields and has become thoroughly established in several places. It will no doubt continue to spread in the cooler cultivated areas. The genus *Deschampsia* sometimes called HAIR GRASS is represented by two unimportant species found only in the higher mountains. One of these, *D. caespitosa*, is not uncommon at moderately high levels in the heavily timbered areas where it finds the soil and climatic condition to which it is adapted and where it adds a small amount to the summer forage crop. Two relatively unimportant species of the genus *Trisetum*, sometimes called FALSE OATS, also occur sparingly in the high mountains in the northern part of the State where they are of little importance adding very little to the crop of summer forage found in the timbered areas of the higher mountains. A fourth genus (*Danthonia*) sometimes called WILD OATS GRASS (though this name is not in use in this region) is represented by three species found in the mountains from near timber-line downward into the zone of the pine timber. None of the species are common or in any way important: they have mostly been collected in New Mexico only a very few times.

* This is a real "Wild Oats" and belongs with the ordinary cultivated species of oats which it resembles. It is not any one of the grasses that are frequently called "Wild Oats" in the mountains of this State, which are really Brome Grasses.

Tribe VI. AVENEAE. OATS GRASSES.

Awns of the flowering glumes attached on the back below the teeth of the glume.

Grain free, unfurrowed; spikelets less than 1-2 an inch long.

Flowering glumes erose-toothed or shortly 2-lobed at the apex.

38. *DESCHAMPSIA*.

Flowering glumes deeply 2-toothed at the apex, the teeth awn-pointed; awn bent and twisted.

39. *TRisetum*.

Grain adherent, furrowed to the glumes; spikelets mostly more than 1-2 an inch long; ovary crowned with a hairy appendage.

40. *AVENA*.

Awns of the flowering glumes attached between the teeth of the glume.

41. *DANTHONIA*.

38. *DESCHAMPSIA* Beauv. HAIR GRASS.

Plant low, 8-16 inches high; empty glumes 4 mm. long; awn much longer than the flowering glume.

1. *D. alpicola*.

Plant taller, 2-3 feet high; empty glumes 3-3.5 mm. long; awn little if any longer than the flowering glume.

2. *D. caespitosa*.

1. *Deschampsia alpicola* Rydb. On the tops of the high peaks in the northern part of the State, in the Arctic-alpine Zone.

2. *Deschampsia caespitosa* (L.) Beauv. In the higher mountains of the State in the Transition and Canadian Zones.

39. *TRisetum* Pers. FALSE OATS.

Panicle slender, interrupted; plant slender.

1. *T. interruptum*.

Panicle dense and crowded, more or less branched but not spreading; plants stouter.

Leaf sheaths and blades long hairy; upper part of the stem densely pubescent.

2. *T. subspicatum*.

Leaf sheaths and blades glabrous or the lowest sheath short pubescent with reflexed hairs; stem glabrous or slightly scabrous in the inflorescence.

3. *T. montanum* Vasey.

1. *Trisetum interruptum* Buckl. Known in New Mexico from a single collection in the southern part of the State in the Upper Sonoran Zone.

2. *Trisetum subspicatum* (L.) Beauv. In the mountains of the northern part of the State in the Canadian Zone extending up into the Hudsonian Zone.

3. *Trisetum montanum* Vasey. In the mountains of the northern part of the State at elevations of 7500 to 9000 feet in the Transition Zone.

40. AVENA L. OATS.

Empty glumes shorter than the flowering glumes; panicle lax, somewhat nodding; flowering glumes hairy at the base. 1. *A. striata*.

Empty glumes longer than the flowering glumes; panicle open; flowering glume often hairy up to the base of the awn. 2. *A. fatua*.

1. *Avena striata* Michx. In the northern part of the State in the Transition Zone.

2. *Avena fatua* L. Wild Oats. An introduced weed found in grain fields in the northern part of the State. Mostly in the Transition Zone.

41. DANTHONIA D. C. WILD OATS GRASSES.

Flowering glumes pubescent only on the margin and at the base. 1. *D. intermedia*.

Flowering glumes hairy on the back as well as on the margins.

Empty glumes 15 to 20 mm. long, 2. *D. parryi*.

Empty glumes 10 mm. long or less. 3. *D. spicata*.

1. *Danthonia intermedia* Scribn. In the mountains in the Transition Zone.

2. *Danthonia parryi* Scribn. Collected once in the high mountains at the north end of the State in the Canadian Zone.

3. *Danthonia spicata* (L.) Beauv. A rare grass of the mountains at the northern end of the State in the Transition Zone.

The Grama Grasses and Their Relatives* (Tribe VII, CHLORIDEAE) form a group that contains a number of genera which are of great importance in the arid region some of which (the Grama Grasses and Buffalo Grass) are the most widely distributed of any species in the West and of more value economically than all the others put together. The tribe also includes Bermuda Grass, the most extensively cultivated species of any in all the arid region. Considering the species in detail we have the following.

See footnote, page 93

SLOUGH GRASS (*Beckmannia erucaeformis*) is a very rare and unimportant species which is to be expected only in the higher mountains of the northern part of the State in soils saturated with water: it often grows in running or stagnant water.

WILD CRAB GRASS (*Schedonnardus paniculatus*) is also of little importance though fairly common where the Blue or White Grama grows. Three of the species of *Chloris* (*C. verticillata*, *C. brevispica* and *C. cucullata*) are economically of little importance in the State because they barely enter it along the eastern border, this line being about the western limit of their distribution. The fourth species of this genus (*Chloris elegans*) is a bad weed in the cultivated fields of the southern part of the State, where it is a common constituent of the later crops of hay. It appears in the alfalfa fields and orchards by the middle of July in the Mesilla Valley and if the irrigation water is scanty it is very apt to crowd out a good deal of the alfalfa since it can live on less water than is necessary to make the alfalfa grow well. Of course it is not altogether bad, for the grass is cut and made into hay with the alfalfa and stock will eat it though they are not very fond of it. Its presence materially lowers the grade and consequently the selling price of the hay in which it occurs in any abundance. *Trichloris fasciculata* is quite rare in the State. It is said to be prized as an ornamental grass by some florists. It is very drought resistant.

Little need be said of the value of BERMUDA GRASS (*Capriola dactylon*) for it is well known in the arid region. It is very drought resistant and a very vigorous and persistent spreading perennial which soon makes a compact sod. It is best to plant pieces of the sod with the rooted underground stems and in one season's time such pieces, if planted six or eight inches apart and properly watered, will completely cover the ground with a thick set sod. Once established, a Bermuda grass lawn may be more abused without killing it out than any other kind of grass. To keep it in good shape it must

be rolled occasionally to flatten the bumps which form and it should be kept mowed. The most serious objection to Bermuda grass is that it will not remain green during freezing weather. Frost kills the stems that are above ground, hence the Bermuda grass lawn is always brown or yellow as long as there is frost at night. It should always be irrigated with clear water.

BUFFALO GRASS (*Bulbils dactyloides*). Much has been said of the value of this grass, probably more than is warranted by the facts. It occurs in the eastern tier of counties in this State forming irregular patches often several square yards in extent. It forms a thick sod and inclines to spread, but it is very small and produces but a small amount of forage in that region. It is probably palatable to stock and quite nutritious as well, but in New Mexico it can in no way compare in importance with the Grama and Galleta grasses (with which it is most frequently associated) even assuming that it is of equally good quality, since there is nothing like the quantity of it. This condition in New Mexico has caused the author to wonder if the Blue or White Grama was really the grass the buffaloes lived upon and the name Buffalo Grass had been applied to another grass accidentally or for a different reason than the obvious one. Its habit of spreading by means of runners makes it very resistant to trampling and also to drought, and once established it seems able to hold its own with the Grama, which is able to crowd out most other plants.

THE GRAMA GRASSES (*Bouteloua* spp. and *Atheropogon* spp.).* These are without question by far the most important range plants in the arid Western grazing lands. In New Mexico there are ten species often referred to the single

* A recently published revision of the genus *Bouteloua* (Contributions from the U. S. National Museum) by Dr. David Griffiths, makes the following changes in the names here used.

B. prostrata Lag.—*B. procumbens* (Durand) Griffiths.

B. vestita (S. Wats.) Scrib.—*B. parryi* (Fourn.) Griffiths

B. polystachya Torr.—*B. barbata* Lag.

B. oligostachya Torr.—*B. gracilis* (H. B. K.) Lag.

Atheropogon curtipendulus (Michx.) Fourn.—*Bouteloua curtipendula* (Michx.) Torr.

A. bromoides (H. B. K.)—*Bouteloua filiformis* (Fourn.) Griffiths.



BUFFALO GRASS. (*Bulbilis dactyloides.*)



BLACK GRAMA. WOOLLY FOOT. (*Bouteloua eriopoda*.)

genus *Bouteloua* but here treated under two generic names. Out of the ten species four are annuals and while they are succulent and palatable when green and fresh, they are of no very great economic importance. Generally speaking the Gramas are found on the drier soils, some species at the lower levels and a few reach altitudes of 7000 feet or even more, especially on high mesa-like plains or plateaus.

Of the annual species three are referred to as Six-weeks Gramas because they reach maturity in the short rainy season of late summer and early fall. Of these three, one (*B. prostrata*) occurs in the timbered parts of the mountains above 6000 feet, almost all over the State. It is of little importance because it occurs mixed with the many other and better grasses of such localities at a time when they are at their best and thus by comparison sinks into insignificance. The other two species (*B. aristidoides* and *B. polystachya*) usually occur on the over-stocked mesas at the lower levels where and when there is little else in the way of food for stock. They thus become of undue importance because they are at once available where nothing else as good is to be had, and are at one and the same time an indicator of the depleted state of a range and the stockman's standby for the summer season. Their seeds are evidently very resistant to dryness or heat and are produced in great numbers; thus it is that whenever the favorable summer conditions arise, these grasses appear in great abundance, whether there has been a good crop of seeds the previous season or not or even for several seasons. The fourth annual species (*B. vestita*) is of no very great importance though it grows on sand hills and dunes where other grasses are usually scarce. It is larger than any of the other three annual species and resembles some of the perennial species more closely, but it is not very common nor very abundant at any place where the writer has ever seen it.

Practically all of the perennial species of Grama are very valuable range grasses though two or three of them are preeminently so. Probably over one third of the total



FEATHER BLUE-STEM. (*Amphilophus Leucopogon*.)

(Reprinted from The Grazing Ranges of Arizona, by J. J. Thornber;
Bull. 65, Arizona Agr. Exp. Station.)



BLUE GRAMA. (*Bouteloua Oligostachya.*)

(Reprinted from *The Grazing Ranges of Arizona*, by J. J. Thorner;
Bull. 65, Arizona Agr. Exp. Station.)

area of range land in New Mexico is more or less completely occupied by the best known GRAMA GRASS (*Bouteloua oligostachya*) which goes under the names "Blue Grama," "White Grama" or more rarely "Crowfoot Grama," the latter name probably incorrectly applied. Why the adjective blue is applied to this grass is not apparent, since it does not appear blue in any way; and white is also unexplainable unless it be in contrast to "Black Grama" to distinguish it from another species. Its Latin specific name is most satisfactory since it means "few spikes," a striking characteristic of the species which distinguishes it from nearly all the others. It grows in small tufts, stools out fairly well, and in places almost produces a sod. The leaves are usually rather numerous, sometimes short and curly, often long when the plant has plenty of water. The flowering culm is from 6 to 18 inches high and bears 1 or 2, rarely 3, one-sided spikes, an inch or so long, near the end. The habit, common to most of the Gramas, of curing as they stand is most pronounced in this species, and it is no uncommon thing to see horses picking at the short dry leaves of Grama a year old instead of eating some other green grass beside it. Chemical analyses show very little differences between the compositions (in the terms in which such analyses are reported) of different grasses some of which are much appreciated by stock and others that the animals will hardly eat at all. Palatability and digestibility and general usefulness of a grass evidently depend upon characteristics not shown by a chemical analysis.

BLUE GRAMA will endure rough treatment and recover rapidly. On the upper plains in New Mexico, at levels of 6000 to about 8000 feet, it is thoroughly at home and perfectly able to take care of itself among all plant rivals. The Galleta Grass (*Hilaria jamesii*) and the Buffalo Grass just mentioned can compete with it on about even terms and maintain their relative positions, but nearly any of the other plants of such regions will be forced out by the Grama if

the natural adjustment of the native plants be not artificially disturbed. Ranges that were once almost pure Grama sod but which have been eaten and tramped out by sheep until occupied largely by "sheep weed" or "snake weed" (*Gutierrezia* spp.) usually recover with considerable rapidity; and the weeds are gradually forced out by the Grama when the stock is taken off and the range allowed to resume a normal condition. This recovery has been very noticeable within the last four or five years in places in the eastern part of the State where the county laws have prohibited the free ranging of stock, these laws having been passed as a protection to the crops of the new settlers. This area has been used by both sheep and cattle in the past for many years, and although it was an excellent range country it has been badly overstocked and the range much depleted, with all the resultant weeds and poor grasses, trails and arroyos.

There is little doubt in the mind of the author that for ordinary stock pastures of the region where Blue Grama grows well in New Mexico, there is no other grass that is so valuable for this purpose, and that the farmers of such regions will do well to husband and encourage it. It is useless to try grasses that require more water because they will not get it. There certainly will be no more rain than now falls and it would not pay to pump water on any kind of pasture grass. The Blue Grama is drought resistant; grows well when it has rain and doesn't die when there is a shortage; seeds well and reproduces by seed whenever there is abundance of fall and winter rain or snow; cures where it stands and is good feed either green or dry. It has all the qualities that fit it for a pasture grass in an arid region and a little bit of encouragement in the form of loosening up the soil so the rain will sink in and not all evaporate will have a salutary effect upon the grass. One very serious difficulty to be met in this region is the fact that farmers are continually expecting the same results as those obtained in a region of greater precipitation, and are, and of necessity must be, dis-

appointed continually until they get to understand that the abundance of vegetation in a region is a pretty close measure of the precipitation (other things being equal). Desert or arid land plants stand just about as thickly as they can and live. The natural adjustment of the plants of a region to their environment is a very delicate and well balanced one and the only substitutions that can be made will be those of plants that will endure conditions about the same as or more unfavorable than those surrounding the native plants of the region. The governing factor in New Mexico is more often water than anything else. Under such circumstances the farmer must (1) either develop more water for irrigation—but in order to make this pay he must do intensive farming of high priced crops; (2) so handle the water which falls on his place as to get the greatest possible advantage from it—i. e. keep the land in the best condition to absorb and retain all the moisture that falls; or (3) cultivate some crop which normally requires less water than the locality supplies,—no such crop has yet been found or developed that will give as desirable results as Blue Grama for a pasture grass in this region. The natural conclusion then is that Blue Grama should be encouraged; but the farmer must not expect a pasture of Blue Grama to produce acre for acre anything like as much feed as Kentucky Blue Grass pastures where the precipitation is 30 to 40 inches instead of from 10 to 15 inches annually.

Much of the land now covered with Blue Grama grass and its natural associates will no doubt ultimately be dry farmed, but some pasture lands will have to be maintained on the farms and it is very probable that the best grasses now known for these lands are the native ones. There is little doubt in the author's mind that the productivity of such pastures can be materially increased by the proper treatment, and that such treatment will be given them. The carrying capacity, however, will always be small as compared with pastures in the humid region with which we are all prone to make comparisons and standardize our judgments.

HAIRY GRAMA (*Bouteloua hirsuta*) is a grass that pretty closely resembles Blue Grama and is frequently associated with that species at the lower levels of its distribution area. It may be recognized by the following characters. It is usually a little smaller, rarely being over 1 foot high: it always has more of the lateral spikes, generally 3 to 5 on a stem: the spikes are shorter, about $\frac{3}{4}$ of an inch long, and broader, they are also more hairy being approximately hirsute; and the rachis of each spike is prolonged conspicuously at the end beyond the last spikelet. This grass usually occurs at lower levels in hotter and drier soils along the foothills of the lower mountains mostly at the southern end of the State. In the southeastern corner of the State it is the best forage plant found on the ranges. In this region it is called Black Grama though that name is probably properly applied to another species.

There seems to be some psychologic reason why people should want to use "Black Grama" as a name, since it is applied to at least four different species of grass in this southwestern arid region, if reports are to be trusted, and none of the grasses are in any sense black. In a recent bulletin on The Grazing Ranges of Arizona* Professor Thornber refers to *Muhlenbergia porteri* as "Black Grama." This grass is here called Mesquite Grass, a name originally given to me by Dr. Vasey. In several of the earlier bulletins relating to the Western range grasses, *Hilaria jamesii* is referred to as "Black Grama." This grass we have called Galleta Grass. Neither of these grasses is in any way even closely related to the genus to which the Gramas belong, though it is well understood that a common name may be applied to any plant without any reference to other applications of similar or seemingly related names.

As has just been noted, in southeastern New Mexico "Black Grama" is *Bouteloua hirsuta* (here referred to as "Hairy Grama" which is almost a translation of its Latin

* Bulletin 65 Arizona Experiment Station.

descriptive adjective) and the former name would seem to fit this grass about as well as it does any of the Gramas, because the little "flags" or spikes are a dark purplish color when they are about mature. The name Hairy Grama is fully as appropriate however, as the spikes are quite noticeably hairy with slender stiffish spreading hairs, more so than any other of our perennial species. In south central and southwestern New Mexico *Bouteloua eriopoda* (woolly footed, the specific name means, on account of the woolliness of the lower sheaths) is known as Black Grama and it is to that grass that the name is here applied. The authors are utterly unable to say whether it was first applied to this species or not. It certainly is not very applicable since the grass is never black or even dark colored. These common names will continue to be applied as they are now in the regions indicated and there is no means of correcting the usage if such correction were necessary: but it seems wise to call attention to the discrepancies. It seems necessary psychologically, for people in this Southwestern region to have a "Black Grama" grass of some kind just as they must have a "greasewood" and a "sage brush" irrespective as to whether these plants grow in the region or not, and this mental attitude no doubt gives rise to the varied usage of the name.

BLACK GRAMA (*Bouteloua eriopoda*) of the southern and southwestern part of the State is a branching perennial with rather weak, spreading stems, bent and angling upwards from a prostrate joint or two at the base. It is moderately leafy, about a foot high, has 3 to 6 slender, loosely-flowered spikes that are not very strikingly one-sided as in some of the other species; it is easily recognized by the thick woolly coating all over the lower joints of the stems. It extends into New Mexico from Chihuahua and forms an important constituent of the range over much of the southern fourth of the former State on the lower mesas and plains. Before this region was heavily stocked it was quite abundant in many places especially on the sandy soils where other grasses are

more or less scarce. Unfortunately it is rather easily killed out and reproduces itself very slowly. It is considerably the most valuable forage of the region it inhabits, with the possible exception of the Mesquite Grass (*Muhlenbergia porteri*) above referred to which Prof. Thornber so correctly states has been practically exterminated in the region, being found now only under the shelter of thorny shrubs where stock cannot get at it. Extended observation has so far failed to show just how or when *Bouteloua eriopoda* reproduces. It always appears as separate plants, stools rather freely, never forms sods, has no runners, does not seem to spread away from a center which dies out as is the case with some grasses, and is very hard to transplant. Seeds do not germinate well and the author has never seen seedlings on the range. It rarely forms a pure stand in New Mexico usually being associated with Tobosa Grass and with the various Needle Grasses. Stock of all kinds like the grass and in many places the mixture of which it is the most important part has been and is still cut for hay, though this practice is much less common now than formerly. The loss of this grass and the Mesquite Grass from the ranges of this State is a very serious one as they are by far the most valuable range grasses of the region they inhabit. Data as to their rate of replacement if it will occur at all, are wanting, but it is doubtless very slow, and not apt to occur while the range is in use. Large areas formerly occupied by these grasses are now either sandy wastes or are more or less covered by weeds that are of no value—and all because of the shortsighted and utterly selfish policy followed in the management of range lands.

TALL GRAMA (*Atheropogon curtipendulus*) is a grass which is very common on dry or rocky hillsides or mountains and to some extent on the higher plains of the State. It is widely distributed throughout the United States and is more or less valuable. The author once heard an experienced cattleman say that it was a valuable grass "to sell a range on."

Stocke at it only when other more palatable grasses are gone and its habit of growing best on rocky slopes protects it to some extent because the animals will not climb up for it as long as other more easily reached food is obtainable. As shown by the illustration the grass has a tall strict stem 18 inches to 2½ feet high with numerous small pendulous spikes arranged along it and a rather large bunch of leaves at the base. The structure of the panicle is characteristic.

Atheropogon bromoides is a more valuable species somewhat resembling the preceding but with lower stems, fewer and larger spikes usually purplish tinged, and slightly less foliage leaves. It is not common in this State occurring so far as is known only in the southwestern part in the lower mountains. Prof. Thornber refers to this grass in Arizona as Spruce-top Grama, in the bulletin previously mentioned.

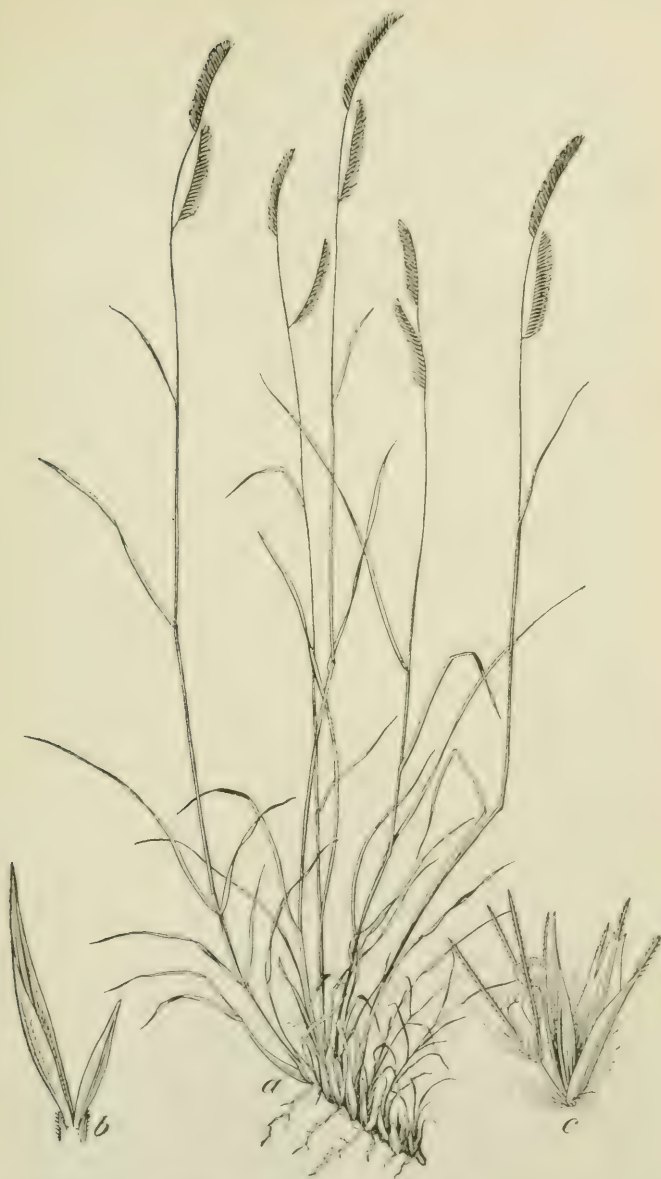
There is one other species of Grama, *Bouteloua breviseta*, for which we have heard no common name, that occurs only on gypsum soils in New Mexico, so far as our observation goes. In general appearance it is most like a "queer" form of Blue Grama and will readily be recognized by its resemblance to that species and its habitat. It is not valuable as forage except for the fact that it will grow on such soils and is a degree better than nothing, a consideration which is sometimes of importance in areas of considerable extent.

SPRANGLE is a name given *Leptochloa dubia** by Mr. James K. Metcalfe who cultivated this and other promising native species for a number of years with the idea of improving the ranges of New Mexico. The name is so satisfactory and applicable to this grass with a sprangling panicle of several long spikes that I suggest its wider use. The grass in question is a rather short-lived perennial which seems most at home on rocky hillsides or in arroyos and does not do very well on flat compact soils. It produces an abundance of seed which germinate rather freely. The mature plant is a

* Called Texas Crowfoot in Bull. 65, Arizona Experiment Station, p 275.

coarse grass often 3 feet high or over with rather abundant green foliage and a large sprangling panicle as seen in the figure. It is a somewhat important addition to the ranges of the southern part of the State though nowhere very abundant.

The other three species of the genus here listed are rather rare grasses of the southern part of the State, of little economic value.



BLUE GRAMA. WHITE GRAMA. (*Bouteloua oligostachya.*)



TALL GRAMA. SIDE-OATS GRAMA. (*Atheropogon curtispendus.*)

Tribe VII. CHLORIDEAE.

- Spikelets unisexual, the different kinds of flowers on the same or different plants. 50. BULBILIS.
- At least some of the spikelets perfect.
- Spikelets with 1 (rarely 2) perfect flowers.
- Rachis jointed just below the spikelet, the whole spikelet falling at maturity. 42. BECKMANNIA.
- Rachis not jointed, the empty glumes persistent.
- No glumes above the perfect flower.
- Spikelets numerous, crowded; spikes 2-6 digitate. 43. CAPRIOLA.
- Spikelets fewer, not so crowded, the spikes slender scattered along a central rachis. 46. SCHEDONNARDUS.
- Glumes above the perfect flowers 1 to several.
- Spikes digitate or crowded together near the end of the stem.
- Flowering glumes with a single awn or awnless. 44. CHLORIS.
- Flowering glumes with 3 awns. 45. TRICHLORIS.
- Spikes more or less scattered along a central rachis.
- Spikes rather few in number, 1 to 6; spikelets numerous, 25 or more. 48. BOUTELOUA.
- Spikes numerous, 12 or more; spikelets few, usually less than 12. 47. ATHEROPOGON.
- Spikelets with 2 or 3 perfect flowers; spikelets alternate. 49. LEPTOCHLOA.

42 BECKMANNIA Host. SLOUGH GRASS.

1. *Beckmannia erucaeformis* (L.) Host. Reported but once from New Mexico. It occurs in very wet soil or beside running water at high levels: may be expected in mountains near the Colorado line.

43. CAPRIOLA, Adans.

1. *Capriola dactylon* (L.) Kuntze. BERMUDA GRASS. Cultivated in the valleys of the lower parts of the State: in the Lower Sonoran Zone.

44. CHLORIS Swartz.

Spikes slender, usually more or less naked at the base or with few scattered spikelets: panicle of more spikes than the verticillate whorl.

1. *C. verticillata*.

Spikes stouter, spikelet bearing to the very base, spikelets crowded: panicle of a single terminal vertical of spikes.

Flowering glume conspicuously hairy, usually long villous on nerves and margin.

2. *C. elegans*.

Flowering glume not conspicuously hairy, pubescence very short or none.

Second flowering glume 3-nerved, obovate-cuneate, apex rounded unequally.

3. *C. brevispica*.

Second flowering glume 7-nerved, broadly triangular wider than long, very short awned.

4. *C. cucullata*.

1. *Chloris verticillata* Nutt. Occasional in the eastern and northern parts of the State in the Upper Sonoran Zone.

2. *Chloris elegans* H. B. K. A common weed in gardens and fields at the lower levels in the Sonoran Zones.

3. *Chloris brevispica* Nash. So far it has been recognized only in the extreme southeastern part of the State. It probably occurs with the next in the eastern tier of counties up to near Portales: in the Sonoran Zones.

4. *Chloris cucullata* Bisch. Known only from the Pecos Valley near Roswell and Carlsbad.

45. TRICHLORIS Fourn.

1. *Trichloris fasciculata* Fourn. Known in New Mexico only from the Mesilla Valley: in the Lower Sonoran Zone.

46. SCHEDONNARDUS Steud. WILD CRAB GRASS.

1. *Schedonnardus paniculatus* (Nutt.) Trelease. A common grass in the mountains of the State in the Transition Zone extending downward into the Upper Sonoran.

47. ATHEROPOGON Muhl.

Spikes small, 30 to 60, each with 4 to 10 spikelets.

1. *A. curtispendus*.

Spikes larger, 5 to 11, each with 3 to 6 spikelets.

2. *A. bromoides*.

1. *Atheropogon curtispendus* (Michx.) Fourn. TALL GRAMA. Common on dry and rocky mountain and hillsides throughout the State, mainly in the Upper Sonoran Zone, but extending into the Lower Sonoran and into the Transition.

2. *Atheropogon bromoides* (H. B. K.) Occurs sparingly in the southwestern corner of the State in the Upper Sonoran Zone.

48. *BOUTELOUA* Lag. GRAMA GRASSES.

Plants annual.

Spike solitary; plant tufted, low.

Spikes more than one.

Spikelets closely appressed to the rachis forming a cylindrical spike: plant tufted 4 to 8 inches high.

Spikelets crowded on one side of the rachis, making it one sided.

Plant a foot high or more; stems erect; spikelets larger than in the next.

Plant 4 to 6 inches high, many stems and widely spreading; spikelets small.

1. *B. prostrata*.

2. *B. aristidoides*.

3. *B. vestita*.

4. *B. polystachya*.

Plants perennial.

Spikes loose more or less cylindric; lower parts of stems densely woolly.

Spikes with more numerous crowded spikelets, one sided; lower parts of stems not woolly.

Empty glumes smooth or slightly roughened.

Empty glumes stiff, hairy.

Spikes 3 to 5, short and broad with conspicuous spreading hairs: rachis extending well beyond the end.

Spikes 1 to 3, mostly 2, longer and narrower, frequently 1-2 inch long, not so hairy; the rachis extending only slightly.

5. *B. eriopoda*.

6. *B. breviseta*.

7. *B. hirsuta*.

8. *B. oligostachya*.

Bouteloua trifida is reported from New Mexico on the strength of two specimens collected by Wright which probably came from Texas.

1. *Bouteloua prostrata* Lag. Moderately common in the mountains; in the Transition Zone. Occasionally referred to as a "six-weeks Grama."

2. *Bouteloua aristidoides* Thurb. SIX-WEEKS GRAMA. Common after the summer rains on the mesas of the southern part

eat it fairly well, but when the seeds ripen the spikelets become very sharp pointed and probably hurt the animals' mouths.

3. *Bouteloua vestita* (S. Wats.) Scribn. An annual of little importance on the sandy mesas of the southern part of the State; in the Lower Sonoran Zone.

4. *Bouteloua polystachya* Torr. Another SIX-WEEKS GRAMA., associated with number 2; in the Lower Sonoran Zone.

5. *Bouteloua eripoda* Torr. BLACK GRAMA. Woolly foot. The commonest and most important range grass of the southern part of the State on the mesas: in the Lower Sonoran Zone, but often occurring sparingly in the Upper Sonoran. This grass spreads slowly by runners and where heavily grazed it probably spreads hardly at all.

6. *Bouteloua breviseta* Vasey. A characteristic grass of the gypsum deposits in the southern and southeastern part of the State; in the Lower Sonoran Zone.

7. *Bouteloua hirsuta* Lag. HAIRY GRAMA. Black Grama. Common on the lower mountains and higher mesas of the southern part of the State; in the Upper Sonoran Zone and extending into the Lower Sonoran.

8. *Bouteloua oligostachya* Torr. BLUE GRAMA. White Grama. Common on the upper plains and in the mountains nearly throughout the State; in the Upper Sonoran and Transition Zones.

49. LEPTOCHLOA Beauv.

Spikes very slender, 1 mm. broad or less; spikelets small, 2- to 4-flowered, scattered.

Spikes much stouter; spikelets generally with several flowers, and crowded.

Plant annual, much branched from the base; flowering glumes short awned.

Plants perennial; flowering glumes awnless.

Panicle elongated and narrow; spikes all ascending; flowering glume pubescent on the keel.

Panicle of about 10 approximated and rather widely spreading spikes; flowering glume smooth.

1. *L. mucronata*.

2. *L. fascicularis*.

3. *L. nealleyi*.

4. *L. dubia*.

1. *Leptochloa mucronata* Kunth. Occasional in the irrigated valleys at the southern end of the State; mostly in the Lower Sonoran Zone.

2. *Leptochloa fascicularis* A. Gray. With the last: mostly in the Lower Sonoran Zone.

3. *Leptochloa nealleyi* Vasey. A single specimen of this species has been collected at Carlsbad: in the Lower Sonoran Zone.

4. *Leptochloa dubia* Nees. SPRANGLE. In the lower mountains and rocky hills of the southern part of the State: in the Upper and Lower Sonoran Zones.

50. **BULBILIS** Raf. BUFFALO GRASS

1. *Bulbilis dactyloides* (Nutt.) Raf. Moderately common in small patches among the other grasses on the plains of the eastern and northeastern parts of the State; in the Upper Sonoran Zone, but extending down into the Lower Sonoran.



SPRANGLE. (*Leptochloa dubia*.)



FALSE NEEDLE GRASS. (*Scleropogon brevifolius.*)

Blue Grass and Its Relatives (Tribe VIII

FESTUCEAE) constitute one of the largest groups and contains some very important grasses, such as the Mutton Grass, Blue Grass, the Fescues and the Brome Grasses. Salt Grass and *Scleropogon brevifolius*, sometimes improperly called Needle Grass, also belong to this tribe and are quite important in parts of our State. The tribe is represented by 17 genera and 68 species and varieties in New Mexico, nearly all of which are indigenous species. In the humid region it is even more important as a tribe producing valuable economic species than it is in this Western region. The New Mexican species are as follows.

Pappophorum wrightii, for which we have heard no common name, is a grass of the rocky hillsides and mesas of the lower southern part of the State. It is important merely as a constituent of a grass flora that will endure extreme drought and produce a scanty crop of forage where little or nothing else will grow.

Scleropogon brevifolius, as has been said, is locally called Needle Grass but is not related closely to the three-awned needle grasses of the genus *Aristida* and we wish to suggest that this grass be called FALSE NEEDLE GRASS. This little grass is a very important one in two ways on the low plains of the southern end of the State. Whether it reproduces readily by seed or not we cannot say. Seeds planted by us did not germinate, but they may have been too old or not properly planted. Further experimentation is necessary to answer the question. But the grass spreads rather rapidly by runners, especially on fine windblown soils. It is not apt to grow on sandy or gravelly soils, but once started on bare flats of fine loess soils there seems to be no degree of heat or dryness which will kill it, and when such areas are flooded—as they frequently are by summer rains and flood waters—this little grass grows rapidly and the patches spread in all directions. The grass is not very valuable forage since stock do not eat it readily nor willingly, but it is the only perennial

grass which is withstanding the effects of severe overstocking in the southern part of the State and it is gradually replacing the much more valuable but much less resistant Black Grama (*Bouteloua eriopoda*) of that region. The author has never seen any evidence which would answer the question of whether the Black Grama can drive it out or not, but the Black Grama is being gradually exterminated by the treatment now given our ranges and the *Scleropogon* is gradually taking possession of all the unoccupied soil upon which it can grow. This is very fortunate (assuming that the Black Grama is already gone) for this little grass will prevent erosion and furnish feed, which while not very good, is at least better than nothing. Preventing erosion is a very important factor in the maintenance of our ranges and particularly of the already scanty supply of water available for stock. Stopping the run-off holds the soil in place and allows the water time to sink into the ground, both of which are of the utmost importance in a region like New Mexico where winds are continuous and strong, where the surface gradient is always pretty steep, where the precipitation is scanty and mostly torrential. Thus this little grass which is able to endure the extremely unfavorable conditions and continue to spread over these hot, dry and dusty plains will in time render these same plains at least less dry and dusty if not less hot, and so make possible the growth of some more valuable vegetation. Its presence tends towards the preservation of the best soils of the lower plains which would otherwise be carried away by every summer storm and in a continuous cloud by the spring winds. In the lower more moist places it is usually accompanied by Tobosa Grass which furnishes at least more abundant and probably slightly better feed, and it is not improbable that the conditions produced by these grasses together are those which are favorable for the growth of other and still better ones. Even if the growth of the *Scleropogon* is not the first of a series of steps tending to benefit such ranges generally, its presence is certainly advantageous, since any grass is better

than none in such regions and the condition has been reduced to that in much of the area over which it occurs.

CARRIZO (*Phragmites phragmites*) is a tall coarse cane that grows in wet soils beside streams or in boggy situations at middle and lower levels, sometimes forming rather large patches. The name is also applied to a still larger introduced plant (*Arundo donax*) which is somewhat extensively grown as an ornamental. Both produce hollow, jointed, woody canes with broad flat leaves somewhat similar to those of corn. *Phragmites* is generally 5 to 6 feet high while *Arundo* is often twice that and correspondingly heavy. Both produce large spreading panicles at the ends of the leafy stems. Grown on a ditchbank where they can get sufficient water each has some ornamental value. The canes of each are not infrequently used by the Mexicans to lay on the small poles that rest on the vigas or rafters in the construction of the roofs of their houses. The mud or adobe of which the roof is composed rests on the reeds of the Carrizo and is prevented from falling through.

FALSE BUFFALO GRASS (*Munroa squarrosa*) is a little spreading annual common on the sandy mesas at the lower levels. It may be recognized by the fact that it seems never to have any panicle of flowers and also by the coating of fine, almost cobwebby hairs which is very conspicuous when the plant is young but disappears with age. The species is of little economic importance though relatively common throughout the State. The flowers are borne in small axillary panicles enclosed in leafy clusters with no stems.

Dasychloa pulchella is a little perennial grass without a common name which grows on the driest of gravelly mesas in the southern part of the State. It is of little value because stock rarely if ever eat it and it never forms a sod.

Erioncuron pilosum is a fairly common little grass on the mesas of the eastern and southeastern part of the State where it is usually associated with the grass society of which Hairy Grama is the dominant grass. It furnishes a small



FALSE BUFFALO GRASS. (*Munroa squarrosa*.)



JUNE GRASS. (*Koeleria cristata*.)

amount of forage but would hardly be noticed except by the collector.

The genus *Tridens* is represented in New Mexico by four species listed further on. None of them is very common or important as forage plants, merely adding slightly to the scanty growth found on the dry rocky hills and mesas of the southern part of the State.

JUNE GRASS (*Koeleria cristata*) is one of the most widely distributed grasses in the mountains of this and adjoining States where it forms a considerable part of the summer forage. It forms "bunches" 4 to 6 inches in diameter with numerous bright green basal leaves 6 to 8 inches long, and several erect stems 10 to 14 inches high each terminated by a rather compact panicle of crowded spikelets, spreading somewhat as they flower. Throughout the Transition Zone and reaching up to the Canadian it is everywhere common.

The genus *Eragrostis*, for which there is no common name is represented in New Mexico by about ten species none of which is of any great importance as a forage grass. CANDY GRASS (*Eragrostis major*) is a pretty annual with a rather sickish sweet odor fairly common in door yards and beside the walks, occasional on the mesas or in the mountains, but stock will rarely eat it. *Eragrostis pilosa* (or *Eragrostis purshii*) if the two are distinct, is a common late summer and fall weed in plowed lands. It does little harm apparently and is of no value as feed. *Eragrostis neo-mexicana*, said by Dr. Scribner to be called Crab Grass in New Mexico (the author has never heard this usage), occurs rather abundantly in the mountains and the seeds are often carried into the valleys with the irrigating water. When small it is difficult to distinguish from the preceding species. Mature well-grown plants are several times as large, with much broader leaves and bigger panicles but with usually fewer flowers in the spikelets and the spikelet of lanceolate outline instead of oblong. It is said to be a valuable hay grass but we have never seen it used in that way. Horses will not eat it while

green. They do not like the queer oily odor. Whether other stock will eat it or not we are unable to say. *Eragrostis secundiflora*, sometimes called Purple Love-grass, and *Eragrostis sessilis* are not uncommon on the sandy soils of the plains in the eastern tier of counties in the State coming in from the States farther east where they are common. They are nowhere sufficiently abundant to be of any economic importance. *Eragrostis pectinacea* and *E. trichodes* also just reach our boundaries on the east and southeast. A perennial grass that goes under the name of *Eragrostis lugens* is rather common in the mountains of the southern part of the State where it adds a little to the forage. It is probable that this name is incorrect as the grass to which the name was applied came from the northern part of South America and distributions of that kind while not impossible are at least uncommon. The name will have to stand until further study can be made. MEXICAN SALT GRASS is the name given to *Eragrostis obtusiflora* which occurs on the playas at the extreme southwestern corner of the State in alkaline soil. This might easily be mistaken for ordinary salt grass which it resembles in many respects but the inflorescence is somewhat different. It is of some importance in the region mentioned and may occur elsewhere, having been overlooked on account of its similarity to Salt Grass.

Three species of *Eatonia* occur in the State none of them of any very great economic importance since they are none of them very abundant nor widely distributed. *Melica parviflora* is a slender, rather weak grass often $2\frac{1}{2}$ feet high with long slender but flat green leaves and a branching panicle of numerous pendulous spikelets, purple tinged on some of the glumes. It is nowhere very abundant but adds its small part to the summer range of the timbered mountains all over the State.

SALT GRASS (*Distichlis spicata*) is a coarse perennial with stiffish leaves and stems, a rather strict panicle, sometimes a little branched, with flattened spikelets of about 10

or a dozen flowers (8 to 16). It is a sod-forming grass, spreading by underground stems and occurs in all the low wet alkaline soils in the State, being most common in the irrigated valleys where the water table comes so close to the surface that the alkali is gradually being concentrated in the upper layer of soil by capillarity and evaporation. Until such soils get to be very strongly alkaline this grass can and does grow in it if there be sufficient water. It is quite common in the Rio Grande and Pecos Valleys at the lower levels and is frequently fenced and used as a pasture grass. It is not very good pasture but is much better than none and because there is no better available it is used somewhat extensively.

The genus *Poa* to which the Kentucky Blue Grass belongs is represented in New Mexico by 17 species most of which are not of any great importance. This is really a small number of species of this very large genus for such an area as New Mexico, but the Poas are mostly grasses of the moist and cool regions and find a poor welcome in this State. Most of our species are restricted to the higher, cool forests and mountain tops above timber line. A few species are quite valuable in the warmer mountains. Among these Mutton Grass is perhaps the most important. The two annual species, *Poa annua* and *P. bigelovii*, are slender, green grasses found only in the mountains in moist, rich soil. They are both small, resemble each other pretty closely, and are of no great importance, though they add some small amount to the summer forage of the timbered areas.

BLUE GRASS or Kentucky Blue-grass (*Poa pratensis*) is too well known to need description. It has been introduced in many places in the State and at the higher levels does very well when it gets enough water. The lower irrigated valleys are really too hot for it, though an occasional energetic and persistent individual manages to make it grow by special care—usually in a small dooryard plat or lawn. At levels above 6000 feet where it is irrigated with clear water it grows very

well. In many places in the mountains beside cool streams it has escaped and is perfectly at home.

Poa arctica, *P. compressa*, *P. aperta* and *P. interior* are all small and rare species known only from the tops of high mountains mostly near or above timber-line. Their most characteristic differences are given in the key following and probably no one but an assiduous collector will ever see them. *Poa occidentalis* Vasey is a tall weak grass that occurs rather commonly in rich moist soil, often in shady places in the timbered mountains. It is from 2 to 3 feet high with a few stems from the root, rather numerous, flat, basal and stem leaves and a loosely spreading panicle of small green spikelets on the ends of rather long and drooping branches. It is never very abundant in any one place but appears as scattered bunches in rather protected situations. It adds a little to the summer forage of such regions. *Poa traceyi* is very like it in superficial appearance but is distinguished by the villous flowering glumes.

MUTTON GRASS (*Poa fendleriana*) is really the only native species of *Poa* that is of much economic value in New Mexico. It is a bunch grass that is usually 12 or 14 inches high with numerous slender leaves forming a thick basal tuft and a rather short and slightly crowded panicle (sometimes a little spreading) of pale colored spikelets. The glumes are usually rather thin though not thin enough to see through them and slightly pinkish tinged. This species usually occurs in the mountains of the southern part of the State and to a less extent in the more northerly parts. Its habit of beginning to grow along in the winter makes it a very good early spring feed when other things are not to be had. It will not grow on the mesas of the lower part of the State because the summer months are too hot and such situations are also too dry for it, but in the foothills of the mountains of this region it does well, commences to grow early and matures its seed usually about the time the other grasses are just beginning to grow. Its name of Mutton Grass arises

from its value as a sheep feed, for which sheep men prize it quite highly. Plans have been made once or twice to carry on some selection and breeding work with this grass because of its promise for the arid region, but they have not yet been carried out. *Poa arida* is a very close relative of the Mutton Grass and was described from plants collected near Socorro. The probabilities are that it came from the Socorro or Magdalena mountains. It is probably a valuable grass and one that will bear closer investigation especially in any attempt to select or breed a pasture grass for parts of the arid region.

The other species of *Poa* listed are not common at any place and not sufficiently widely scattered to be of much economic importance. Considerable more attention should be paid to the genus by collectors especially in the mountains of the northern part of the state since there are doubtless several other species than those listed here, that do come into that part of the State.

MANNA GRASS (*Panicularia nervata*) is a tall slender and weak grass that grows along stream banks and on cool north slopes where the soil is wet and shaded. The plants are always scattering, never numerous, and consist of but one or two stems with a few basal and stem leaves. The small strongly nerved glumes and weakly drooping panicle with few branches are characteristic. The grass but adds a small amount to the summer forage of the cooler timbered areas.

THE FESCUE GRASSES (*Festuca* spp.) sometimes called Rescue grasses, are moderately common in the upper timbered areas of the State from elevations of 7500 feet (or less for the small annual species) to above timber-line. The annual species, *Festuca octoflora*, is a common early fall or late summer grass or it may come earlier if there is plenty of snow or rain. It grows well and rapidly, but is rarely over 4 to 6 inches high and is never very abundant, and is valuable only as a small part of that rare thing, spring and early summer feed, in the foothills and lower slopes of the

mountains. As noted further on *Festuca pacifica* is reported from New Mexico on the strength of a small, scrappy specimen from near Las Vegas, collected by Prof. T. D. A. Cockerell. The determination may be incorrect on account of the meagerness of the material. It is hardly to be expected that the species should occur in our region as it normally is a Pacific Coast species.

TALL FESCUE or Meadow Fescue (*Festuca elatior*) has been tried at several places as a pasture grass but with rather indifferent success. As an escape it occurs in a few places in the higher mountains.

ARIZONA FESCUE (*Festuca arizonica*) is an important grass on the higher mountains in the open parks at 8000 feet elevation or higher and on open burns or mountain peaks or ridges near or even above timber line. It grows as a bunch grass but on mountain slopes or on burnt areas it quite commonly occurs as almost pure stands in which the bunches stand only a few inches apart. It is of great importance as an early summer feed, especially for sheep which eat it when it is young and tender. It is good for horses but the mature grass is eaten by sheep only when there is nothing else. It is usually 18 inches to 2 feet high, in dense bunches or tufts 6 inches in diameter or more, with numerous narrow basal leaves 8 inches to a foot long and several to many panicle-bearing stems from each tuft. The stems are slender but wiry and elastic with a loosely spreading panicle of medium size. The flowering glumes are green (not thin) and narrowly lanceolate terminating in a short awn. On account of its habit and its abundance in the locations in which it occurs it can hardly be mistaken for anything else. It will grow only at the higher and cooler levels. Two or three other species of *Festuca* occur sparingly at high levels in the mountains as is indicated in the list, but they are of little importance.

THE BROME GRASSES (*Bromus* spp.) are common in the mountains of the State, mostly in the timber covered portions, where they are generally known by the name of Wild

Oats and are considered valuable forage plants. Of the thirteen species and varieties listed further on, four are introduced cultivated species. Of these *Bromus unioloides* is a good spring and early summer annual. It escaped years ago on the Agricultural College farm and has appeared each spring, before anything else commenced to grow, along the ditches and beside the walks. The plant is of course no competitor with alfalfa but it should be valuable at higher levels where a short season grass is necessary. It should grow well where oats will. UNARMED BROME (*Bromus inermis*), *B. racemosus* and *B. secalinus* (CHEAT), have all been tried at various places with varying degrees of success. They all prefer the cooler and moister conditions and most of them will grow in the timbered areas.

Of the native species and varieties there are two general types that are easily recognized. One has upright and rather stiffly spreading panicles and flattened spikelets, the spikelets spreading or bending downward a little; the other has a weakly nodding panicle with all the spikelets hanging downward and the spikelets themselves almost spindle-shaped. To the former group are to be referred the varieties of *Bromus marginatus* (both of which are rather rare in New Mexico) and *B. polyanthus* and its variety, which are quite common in the mountains in the timbered areas.

Bromus porteri and its close relatives *B. lanatipes* and *B. frondosus* are the species of the other type that occur in New Mexico, and the first is quite common. In the opinion of the authors these grasses have not received sufficient attention as hay grasses in our mountain areas. They are perennials, possibly only short lived, but they grow very readily in all the small cultivated valleys and "parks" of the timbered areas of our higher mountains. In the cultivated fields and gardens of these levels they are to be found growing as "weeds," thus indicating how readily they would grow if cultivated. They are rather coarse grasses 2 to 2½ feet tall with abundance of leaves and stool out considerably.

They produce abundance of seed and no doubt grow readily from seed. The same sort of treatment that is given oats would no doubt result in a crop of brome hay and a meadow that would be valuable for several years. Those regions in which the brome grasses occur most commonly and in which they would no doubt be most valuable as hay grasses, although occupied are nowhere intensively or extensively farmed in New Mexico as yet. In such locations there is abundance of summer feed for all kinds of stock to be had for the gathering, and the animals are left to gather it, while the owner merely gathers the animals. The small amount of feed that is necessary for the short winter is usually obtained by growing a crop of oats which is cured as hay. In some places a little alfalfa is grown especially if the land can be irrigated. Thus with a little garden for the household vegetables, a few milch-cows, a few acres of oats and corn and a few cattle on the range to supply the necessary cash, the mountain farmer has most of his wants supplied and is but little interested in improved farming methods. Doubtless when the land is much more thickly populated than now, advantage will be taken of more of these latent possibilities of the region. The authors would call the attention of such farmers to these native brome grasses with the suggestion that they probably have at their very doors a good hay grass thoroughly adapted to the region, that will stand the spring droughts better and mature a crop more regularly than anything in the grass line that they can plant, and that once established it will probably produce several crops with the minimum of labor. It is certainly well worth trying on a small scale at least.

Tribe VIII. FESTUCEAE.

- | | |
|---|--------------------------|
| Flowering glumes with numerous (9 or more) awn-like divisions or awned lobes. | 51. <i>PAPPOPHORUM</i> . |
| Flowering glumes with fewer lobes or entire. | |
| Flowering glumes, at least of the pistillate spikelets, 3-lobed and 3-awned: plant dioecious, staminate glumes not awned. | 52. <i>SCLEROPOGON</i> . |
| Flowering glumes entire, or at most 2-lobed. | |
| Hairs on the rachilla or the flowering glume very long and enclosing the latter. | 53. <i>PHRAGMITES</i> |

Hairs, if any, on the rachilla and flowering glume shorter than the glume.

Stigmas barbellate or long styles: spikelets in threes in the axils of spinescent leaves; plant prostrate spreading, cobwebby or woolly while young.

54. MUNROA

Stigmas plumose, sessile or on a short style.

Flowering glumes 1- to 3-nerved.

Lateral nerves of the flowering glumes hairy.

Flowering glumes deeply 2-lobed.

55. DASYPHLOA

Flowering glumes entire or slightly 2-lobed.

Inflorescence a short crowded raceme; leaf blades with thick cartilaginous margin: plant low and tufted.

56. ERIONEURON

Inflorescence a panicle: leaf blades without cartilaginous margin; plants taller.

57. TRIDENS

Lateral nerves of the flowering glumes glabrous.

Second empty glume similar to the first or nearly so.

Panicle narrow, dense and spike-like, shining, its branches erect.

58. KOELERIA

Panicle open, its branches spreading.

59. ERAGROSTIS

Second empty glume unlike the first one, broad at the summit.

60. EATONIA

Flowering glumes 5- to many-nerved.

Spikelets with two or more of the upper glumes empty, broad and enfolding each other.

61. MELICA

Spikelets with the upper glumes flower-bearing or narrow and abortive.

Stigmas placed at or near the apex.

Glumes more or less laterally compressed and keeled.

Plant dioecious: flowering glume of the pistillate spikelet coriaceous; plants of alkaline flats and valleys.

62. DISTICHLIS

Plants with mostly perfect flowers: flowering glumes thin, scarious margined: plants of the mountains.

64. POA

Glumes rounded on the back at least below the middle.

Flowering glumes obtuse or acutish and scarious at the apex, usually toothed.

Style present: flowering glume distinctly 5-to 7-nerved.

65. PANICULARIA

- | | |
|---|-----------------|
| Style none; flowering glume obscurely 5-nerved. | 65. PUCCINELLIA |
| Flowering glumes acute, pointed or more commonly awned at the apex. | 66. FESTUCA |
| Stigmas plainly arising from below the apex of the ovary, the latter tipped by a hairy cushion. | 67. BROMUS |

51. PAPPOPHORUM Schreb.

1. *Pappophorum wrightii* S. Wats. On the lower, drier and rockier ridges and mountains of the southern part of the State, in the Sonoran Zones.

52. SCHLEROPOGON Philippi. FALSE NEEDLE GRASS

1. *Schleropogon brevifolius* Philippi. On the mesas of the southern part of the State in the Lower Sonoran Zone.

53. Phragmites Trin CARRIZO.

1. *Phragmites phragmites* (L.) Karst. The common reed grass found in wet soil in slowly running or stagnant water at the lower levels, though sometimes as high as the Transition Zone: mostly in the Lower Sonoran Zone.

Arundo donax L. is an introduced species of reed or cane-like grass resembling the preceding but much larger. It is in cultivation in the lower Rio Grande Valley.

54. MUNROA Torr.

1. *Munroa squarrosa* (Nutt.) Torr. A common annual of short duration with inconspicuous inflorescence, found on the sand hills and mesas of the Lower Sonoran and to some extent in the Upper Sonoran Zone.

55. DASYCHLOA Willd.

1. *Dasychloa pulchella* (H. B. K.) Willd. A common species of the very driest and rockiest of the mesas of the Lower Sonoran Zone.



ARIZONA FESCUE, PINE GRASS. (*Festuca arizonica*.)

(Reprinted from The Grazing Ranges of Arizona, by J. J. Thornber;
Bull. 65, Arizona Agr. Exp. Station.)



NEEDLE GRASS. (*Aristida Divaricata*.)

(Reprinted from The Grazing Ranges of Arizona, by J. J. Thornber;
Bull. 65, Arizona Agr. Exp. Station.)

56. **ERIONEURON** Nash.

1. **Erioneuron pilosum** (Buckl.) Nash. A not uncommon little grass of the higher mesas of the southern and eastern part of the State: mostly in the Upper Sonoran Zone.

57. **TRIDENS** R. and S.

Flowering glumes not pilose on the back; empty glumes considerably surpassing the lower flowers of the spikelet.

1. *T. albescens*.

Flowering glumes pilose on the back at least at the base. Empty glumes smaller, barely as long as the lowest flowers or shorter.

First flowering glume strongly ciliate, deeply 2-lobed with an intermediate, short awn.

Flowering glumes only slightly 2-cleft at the apex sometimes hardly at all so; lobes if present narrow, acute.

2. *T. grandiflorus*.

Flowering glumes cleft 1-2 of their length; lobes rounded obtuse.

3. *T. nealleyi*.

First flowering glume not ciliate, nor lobed and without any awn.

4. *T. muticus*.

1. **Tridens albescens** (Vasey). In the valleys at the southern end of the State: in the Lower Sonoran Zone.

2. **Tridens grandiflorus** (Vasey). A single specimen is in the herbarium from near Kingston. It probably occurs occasionally in the mountains of the southern part of the State.

3. **Tridens nealleyi** (Vasey). A rather rare grass in the Lower Sonoran Zone.

4. **Tridens muticus** (Torr.) Nash. At the lower levels on mesas and in the valleys, in the Lower Sonoran Zone.

58. **KOELERIA** Pers. JUNE GRASS

1. **Koeleria cristata** (L.) Pers. One of the commonest and most attractive looking grasses of the timbered areas of the State: in the Transition Zone, sometimes reaching into the Canadian Zone.



Eragrostis neo-mexicana.



SALT GRASS. ALKALI GRASS. (*Distichlis spicata.*)

59. *ERAGROSTIS* Beauv.

Annual plants.

Spikelets broad, over 2 mm. wide.

Spikelets narrow, 1.5 mm. wide or less.

Low spreading plant, about a foot high, often only a few inches; leaves narrow; flowers numerous in the spikelet; usually found in cultivated fields in the valleys.

Plant taller, 1 to 3 feet when mature; leaves broader; flowers fewer in the spikelet; usually seen in the mountains.

Panicle spreading, often nearly 1 foot long; spikelets 5 to 8 mm. long.

Panicle somewhat contracted, 4 inches long or less; spikelets 3 to 6 mm. long.

Perennial plants.

Plant with rigid, scaly, rootstocks; having the habit of salt grass; leaves pungent pointed.

Plants tufted, without rootstocks; leaves not pungent pointed.

Spikelets crowded, on short branches.

Branches of panicle ascending; spikelets conspicuously flattened, 8 to 40 flowered, broadly oblong, spreading away from the branches; glumes reddish tinged.

Panicle widely spreading; spikelets not much flattened 5- to 12-flowered, narrowly oblong, appressed; glumes green.

Spikelets few flowered and small, on the ends of slender elongated branches.

Branches of the narrow and elongated panicle long and flexuous, erect or nearly so; lateral nerves evident.

Branches of the rather open panicle spreading or ascending, rather rigid.

Lateral nerves of the flowering glumes faint; a common grass in the mountains.

Lateral nerves of the flowering glumes very prominent; a rare grass coming into this State from Texas.

1. *E. major*.

2. *E. pilosa*.

3. *E. neo-mexicana*.

4. *E. mexicana*.

5. *E. obtusiflora*.

6. *E. secundiflora*.

7. *E. sessilispica*.

8. *E. trichodes*.

9. *E. lugens*.

10. *E. pectinacea*.

1. *Eragrostis major* Host. A most common annual grass of the mesas and valleys of the southern part of the State; mostly Lower Sonoran.

2. *Eragrostis pilosa* (L.) Beauv. With difficulty distinguishable from small plants of the next species; generally occurs in the Lower Sonoran Zone where it is a common summer annual.

3. *Eragrostis neo-mexicana* Vasey. About the commonest

annual species of the genus in the State, occurring mostly in Transition Zone but extending downward occasionally.

4. *Eragrostis mexicana* Link. A rare species of the mountains of the southern part of the State; in the Upper Sonoran Zone.

5. *Eragrostis obtusiflora* Scribn. An alkali loving species known only from low alkaline flats in the southwestern part of the State; in the Lower Sonoran Zone.

6. *Eragrostis secundiflora* Presl. A very pretty grass occurring moderately frequently on the plains of the eastern side of the State, in the Upper and Lower Sonoran Zones.

7. *Eragrostis sessilispica* Buckl. Collected but once, on the sand hills just south of Melrose.

8. *Eragrostis trichodes* (Nutt.) Nash. A rare species known only from the southeastern part of the State in the Upper Sonoran Zone.

9. *Eragrostis lugens* Nees. There is good reason to believe that this determination is incorrect, since this species originally came from South America. The plant here referred to is rather common in the drier mountains especially in the southern part of the State in the Upper Sonoran Zone.

10. *Eragrostis pectinacea* (Michx.) Steud. Rare in the extreme eastern edge of the State south of Portales, probably coming in from Texas; in the Upper Sonoran Zone.

60. *EATONIA* Raf.

Second empty glume not much wider, if at all, than the flowering glumes, obtuse or acute, thin and with a broad scarious margin.

Second empty glume much wider than the flowering glumes, rounded or truncate and somewhat cucullate at the apex.

Intermediate nerves of the second glume faint; leaves narrow; panicle very narrow, dense, and spike-like.

Intermediate nerves almost as prominent as the main ones; leaves wider; panicle longer and broader, and not so strict.

1. *E. pennsylvanica*.

2. *E. obtusata*.

3. *E. robusta*.

L

1. *Eatonia pennsylvanica* (D. C.) Gray. In the mountains of the northern part of the State; mostly in the Transition Zone.

2. *Eatonia obtusata* (Michx.) Gray. In the lower and drier mountains in the Upper Sonoran Zone, though sometimes coming into the irrigated valleys of the southern part of the State.

3. *Eatonia robusta* (Vasey) Rydb. Along streams and on ditches in the southern part of the State; in the Lower Sonoran Zone.

61. *MELICA* L. MELIC GRASS.

1. *Melica parviflora* (Porter) Scribn. Moderately common in the mountains throughout the State; in the Transition Zone, but often in the Upper Sonoran.

62. *DISTICHLIS* Raf. SALT GRASS.

1. *Distichlis spicata* (L.) Greene. The True Salt Grass, found everywhere in the low wet alkaline lands through the State; mostly in the Lower Sonoran Zone, but often higher.

63. *PUCCINELLIA* Pasl.

1. *Puccinellia airoides* (Nutt.) Walter. A rather uncommon grass from the lower parts of the mountains of the northern end of the State; in the Upper Sonoran Zone.



MUTTON GRASS. (*Poa fendleriana*.)



WILD OATS. (*Bromus porteri.*)

64. POA L. BLUE GRASS, MEADOW GRASS.

Annuals.

Plant low, 4 to 8 inches high; branches of panicle spreading.

Plant taller, erect, 6 to 20 inches high; branches of panicle erect.

1. *P. annua*.

2. *P. bigelovii*.

Perennials.

Cobweb at the base of the flowers present, though sometimes scanty; flowering glume acute (except in *P. compressa*) and usually strongly keeled; plants with horizontal rootstocks, never true bunch grasses.

Intermediate nerves of the flowering glumes strong.

Panicles with numerous many-flowered spikelets, the branches in fruit ascending, the lower ones in 3's and 4's; flowering glumes acutish; cobweb copious.

Panicles usually with few-flowered spikelets, the branches reflexed or spreading in fruit; flowering glumes very acute.

Spikelets few and usually purplish; branches of the panicle few, solitary or in pairs; cobweb scanty.

Internerves of the flowering glumes long hairy; leaves narrow, more or less inrolled.

Internerves of the flowering glumes glabrous, hairs on the mid nerves and lateral nerves copious and spreading.

Spikelets many, green; branches of the panicle many, the lower ones often in 3's and 4's.

Flowering glumes slightly pubescent on the keel below.

Flowering glumes white pubescent on the back below, villous on the marginal nerves and keel.

Intermediate veins of the flowering glumes faint or obsolete.

Stem compressed; panicles narrow, open.

Stems not compressed.

Branches of the panicle reflexed.

Branches of the large panicle not reflexed.

Cobweb at the base of the flowers wanting; spikelets acute at the base; empty glumes not very broad nor strongly arched on the back; flowering glumes about 5 mm. long or more; plants tolerably good sized.

Spikelets only slightly flattened; flowering glumes narrow, nearly straight on the back, rounded at the apex; mostly bunch grasses with narrow panicles; stem leaves narrow.

Flowering glumes merely scabrous throughout.

Flowering glumes more or less strigose on the lower portion, scabrous above; plant yellowish green.

3. *P. pratensis*.

4. *P. arctica*.

5. *P. reflexa*.

6. *P. occidentalis*.

7. *P. tracyi*.

8. *P. compressa*.

9. *P. aperta*.

10. *P. interior*.

11. *P. laevigata*.

12. *P. lucida*.

Spikelets decidedly flattened; flowering glumes acute; nerves of the flowering glumes villous but the internerves glabrous; plants dioecious.

Ligules long, 5 to 7 mm., acute or acuminate.

Ligules short, rounded or truncate at the apex.

Panicle very narrow and long peduncled, contracted.

Panicle more open, at least when in flower.

Panicle very short; plant low; leaves smooth below, scabrous above.

Panicle longer, 3 to 6 inches; plants 1 to 2 feet high.

Empty glumes nearly equal, 3-nerved; leaves smooth below, scabrous above.

Empty glumes unequal, the first 1-nerved the second 3-nerved; leaves scabrous below hispid-puberulent above.

13. *P. longiligula*.

14. *P. longipedunculata*.

15. *P. brevipaniculata*.

16. *P. arida*.

17. *P. fendleriana*.

1. *Poa annua* L. A fairly common annual in the Transition Zone in the northern part of the State.

2. *Poa bigelovii* V. and S. A common annual in the mountains throughout the State in the Transition Zone and occasionally in the Upper Sonoran.

3. *Poa pratensis* L. BLUE GRASS. Not uncommon as an escape in the mountains in the Transition and Canadian Zones. Often cultivated at the higher levels as a lawn grass.

4. *Poa arctica* R. Br. In the Arctic-alpine Zone, on high peaks in the northern part of the State.

5. *Poa reflexa* V. and S. Known in New Mexico from a single collection by Fendler (No. 929), probably from near Santa Fe though not certainly. May not be New Mexican.

6. *Poa occidentalis* Vasey. One of the commonest of the Poas in the cooler timbered mountains at middle and higher elevations in the Transition Zone extending into the Canadian.

7. *Poa tracyi* Vasey. Known only from the type locality near Raton. It may not be a valid species.

8. *Poa compressa* L. A rare species from the high mountains at the northern end of the State in the Canadian Zone.

9. *Poa aperta* Scribn. Like the last in distribution; on high mountains in the Canadian and Hudsonian Zones.

10. *Poa interior* Rydberg. Found on rocky ledges near timber line in the Hudsonian Zone and lower in cold wet meadows.

11. *Poa laevigata* Scribn. In cool wet meadows in the mountains; in the Transition Zone; not common.

12. *Poa lucida* Vasey. In similar situations to the last.

13. *Poa longiligula* Scribn. and Williams. Known in New Mexico from two collections near Aztec; probably an Upper Sonoran species.

14. *Poa longipedunculata* Scribn. In the Transition Zone in the mountains of the northern part of the State.

15. *Poa brevipaniculata* Scribn. and Wilcox. Known in New Mexico from near Las Vegas on dry hillsides in the Upper Sonoran Zone.

16. *Poa arida* Vasey. Very similar to the next and in similar though possibly drier situations and extending downward into the Lower Sonoran Zone.

17. *Poa fendleriana* (Steud.) Vasey. MUTTON GRASS. A grass much prized by sheep men fairly common in the drier parts of the mountains throughout the State; in the Upper Sonoran Zone.

65. PANICULARIA Fabr. MANNA GRASS

Spikelets small, 3 mm. long or less; branches of the panicle weak and drooping.

1. *P. nervata*.

Spikelets larger 4 to 6 mm. long; branches of the panicle ascending or spreading.

2. *P. americana*.

1. *Panicularia nervata* (Willd.) Kuntze. A fairly common grass of the cooler timbered areas in the mountains; in the Transition Zone extending into the Canadian.

2. *Panicularia americana* (Torr.) MacM. A coarse grass growing in wet soil beside streams and springs mostly in the Upper Sonoran Zone.

66. *FESTUCA* L. FESCUE GRASSES.

Annuals or biennials.

Spikelets loosely 1- to 5-, rarely 6 flowered.

Spikelets densely 8- to 13-flowered.

1. *F. pacifica*.

2. *F. octoflora*.

Perennials.

Empty glumes thin, ovate-lanceolate, more or less scarious; second glume 1-nerved or 3-nerved only at the base; ligules long and acuminate.

3. *F. thurberi*.

Empty glumes firm, the second 3- to 5-nerved.

4. *F. brachyphylla*.

Plant low, less than 1 foot high.

Plants much taller, fully 2 feet high or more.

5. *F. arizonica*.

Leaf blades very narrow and filiform, involute, dull gray green.

Leaf blades wider and flat (not involute), bright green.

Spikelets narrow, 3- to 5-flowered.

6. *F. fratercula*.

Spikelets ovate or oblong, 5- to 11-flowered.

7. *F. elatior*.

1. *Festuca pacifica* Piper. A Pacific Coast grass collected but once near Las Vegas. The determination may not be correct as the material was scanty.

2. *Festuca octoflora* Walt. A common North American species occurring in dry soils in the Sonoran Zones.

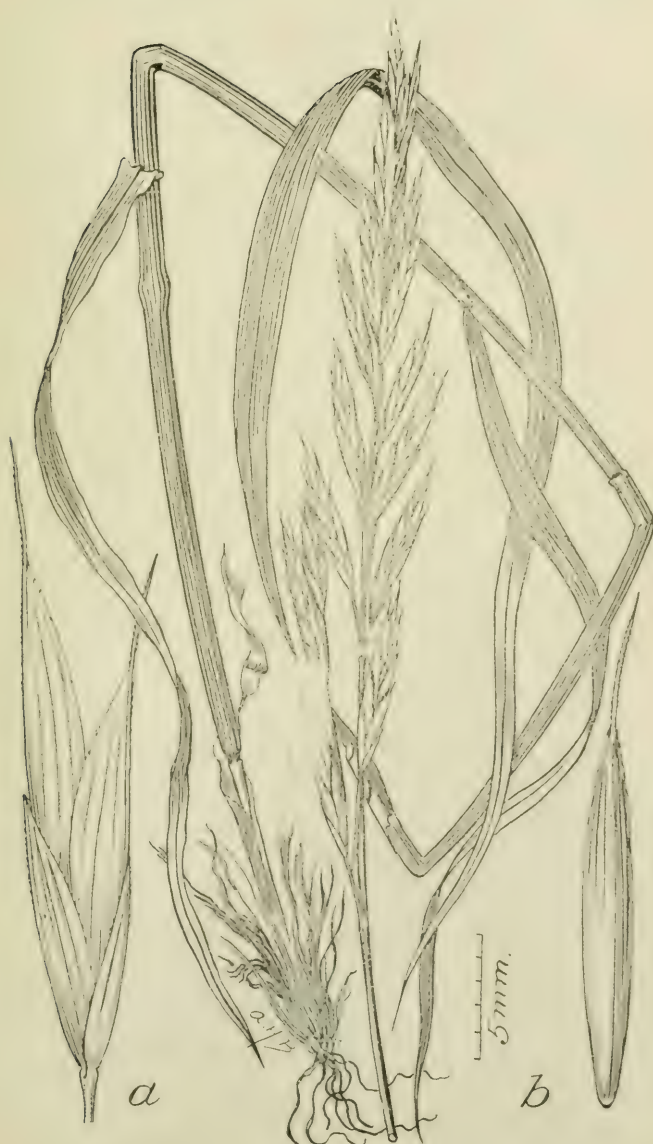
3. *Festuca thurberi* Vasey. A high mountain species occurring in the Canadian and Hudsonian Zones.

4. *Festuca brachyphylla* Schultes. On the high mountains in the northern part of the State in the Hudsonian and Canadian Zones and into the Arctic-alpine Zone.

5. *Festuca arizonica* Vasey. ARIZONA FESCUE. Common in the cooler forests and on open burns in the high mountains: a valuable grass. In the Canadian and Hudsonian Zones, sometimes coming into the Transition.

6. *Festuca fratercula* Rupr. Also found on the high mountain peaks; rare.

7. *Festuca elatior* L. TALL FESCUE. Has been introduced at various places and escaped at the higher levels in the mountains.



WILD OATS. (*Bromus polyanthus.*)



SLENDER WHEAT GRASS. (*Agropyron tenerum*.)

67. **BROMUS** L., BROME GRASS. WILD OATS.

Flowering glumes compressed-carinate at the base.

Flowering glumes appressed-villous.

Sheaths more or less villous.

Sheaths and leaves glabrous or nearly so.

1. *B. marginatus latior*.

2. *B. marginatus seminudus*.

Flowering glumes smooth or scabrous.

Leaves and sheaths noticeably pubescent; annual.

3. *B. unioloides*.

Leaves not pubescent, sheaths sometimes slightly so; perennial.

Leaves narrow, awns short.

4. *B. polyanthus*.

Leaves broader, awns longer.

5. *B. polyanthus paniculatus*.

Flowering glumes not compressed-carinate but rounded on the back at least at the base.

Flowering glumes glabrous or scabrous.

Sheaths pubescent.

Panicle dense, contracted; plant low.

6. *B. hordeaceus glabrescens*.

Panicle loose, more or less spreading; plant taller.

7. *B. racemosus*.

Sheaths glabrous.

Spikelets laterally compressed, ovate-lanceolate.

8. *B. secalinus*.

Spikelets terete long and narrow.

9. *B. inermis*.

Flowering glumes appressed villous at least near the base.

Pubescence unequally distributed over the back of the flowering glume, densest below and on the margin.

10. *B. richardsonii*.

Pubescence about equally distributed over the back of the flowering glume.

Sheaths densely pilose-pubescent.

11. *B. lanatipes*.

Sheaths never densely pilose, occasionally slightly hairy in *B. porteri*.

Lower empty glume 3-nerved.

12. *B. porteri*.

Lower empty glume 1-nerved.

13. *B. frondosus*.

Bromus ciliatus is reported from several different localities but the citations probably rest on incorrect determinations.

1. *Bromus marginatus latior* Shear. From the mountains of the southwestern part of the State in the Upper Sonoran and Transition Zones.

2. *Bromus marginatus seminudus* Shear. Occurs in the mountains of the southern part of the State mostly in the Transition Zone.

3. *Bromus unioloides* H. B. K. BROME GRASS of the seedsmen. This species has escaped extensively along the ditches on the

Agricultural College farm and at other places in the State; in the Sonoran Zones.

4. **Bromus polyanthus** Scribn. One of the commonest of the bromes or Wild Oats grasses of the timbered mountain areas throughout the State, in the Transition Zone.

5. **Bromus polyanthus paniculatus** Shear. Much like the last but usually somewhat stouter, occurring in the same regions and Zone.

6. **Bromus hordeaceus glabrescens** (Coss) Shear. Recorded from but a single locality in the Mogollon Mountain region, in the Canadian Zone.

7. **Bromus racemosus** L. Another common cultivated Brome grass, introduced in the Mesilla Valley.

8. **Bromus secalinus** L. A cultivated species often sold by seedsmen in "grass mixtures" for lawns or meadows. Not common in New Mexico.

9. **Bromus inermis** L. UNARMED BROME GRASS. A cultivated species growing on the Agricultural College farm.

10. **Bromus richardsonii** Link. Occurs in the higher parts of the timber covered mountains at elevations of 8500 feet and over not uncommonly; in the Canadian Zone coming down into the Transition.

11. **Bromus lanatipes** (Shear) Rydb. One of the common species occurring in the Transition and coming down into the Upper Sonoran Zones.

12. **Bromus porteri** (Coul.) Nash. Common in the timber covered areas of the mountains, in the Transition Zone; occasionally lower.

13. **Bromus frondosus** (Shear). Similar to the last except that it ranges a little lower; in the Upper Sonoran, occasionally in the Transition.

The Rye Grasses and Wheat Grasses. (Tribe IX. HORDEAE) are represented by 4 native genera and 23 species in New Mexico, besides the various cultivated species such as wheat, rye, barley, etc., most of which grow freely at various places in the State. The possibilities in wheat raising in New Mexico are not appreciated by most of our farmers. Barley for both hay and grain is grown quite extensively in the higher mountains where they get plenty of summer rains.

THE WHEAT GRASSES of the genus *Agropyron* are common throughout the State, 10 or possibly 11 species being recognized. They are all restricted to the higher levels and occur mostly in the mountains, rarely coming down on the plains, though one species, Colorado Bluestem occasionally occurs on the higher grassy plains at the northern end of the State. Most of the New Mexican species of this genus are not common and are found only on the upper parts of the high mountains, several of them occurring above timber line and a few more in the cool forests just a little below the upper limit of trees. These species are of such small importance from the standpoint of value as forage that they need hardly be noted.

THE SLENDER WHEAT GRASS (*Agropyron tenerum*) (as here considered) is however, quite an important grass. It occurs in wet meadows and cienagas at levels of 7500 up to about 9000 feet and produces excellent forage: it is often cut for hay along with the other grasses and sedges that grow in such places. This grass is somewhat variable, or there are two species—the question is not yet settled to the author's satisfaction, and, pending further study in the field, the different forms are here referred to by a single specific name—the older. In several texts the two names are given and the keys are made so as to attempt the separation, but the failure of the keys to work on material and the inability of the authors to find characters in a large series of dried specimens by which to separate the two forms have led to the above conclusion. The grass if it be a single species is a leafy peren-

nial growing from 2 to 3½ feet or even 4 feet high with erect stems, and a spikelike panicle suggestive of a rather slender head of beardless wheat, 5 or 6 inches long. The grass produces numerous flat bright green leaves and grows in stools much as wheat does, though one of the forms here included is said to be stoloniferous. It forms a valuable part of the summer forage in the mountains and is a hay grass whose value is not yet appreciated in New Mexico. In Colorado it is encouraged by some farmers. The slender form with more or less interrupted spike is proper *Agropyron tenerum*. To the stouter and lower forms with a crowded and larger spike the name of *Agropyron pseudorepens* has been given. They are about equally common in New Mexico.

COLORADO BLUESTEM (*Agropyron smithii*)* is one of the important forage grasses of the State. It probably comes in from the North where it is common on the plains or foothills. In New Mexico it is always found on dry hillsides and slopes of poor and dry mountains from about 5,500 feet up to over 7000 feet, where it is very common among the pine trees. It occurs very rarely on the plains. It is said to be a very good pasture and hay grass in the northern Rocky Mountain region. In New Mexico though it is eaten to some extent, stock prefer dry grama to fresh Bluestem. It rarely occurs in pure stand sufficiently thick to warrant cutting for hay but often produces a scattering growth under pine trees. It is a bluish-green grass usually a foot to 14 inches high, with only a few stems (1 to 3 or 4) in a place, rather coarse and wiry with a somewhat flattened spike-like panicle 3 to 7 inches long, the glumes lanceolate and acuminate pointed but not awned. The plant spreads by means of slender rootstocks, but

*Within the past 10 or 15 years the name of this grass has been changed quite frequently. It was first referred to *A. repens* an Eastern species. Then it was recognized as *A. repens* var. *glaucum*. Then it was considered as a separate species and the usual custom followed and it was called *A. glaucum*. But the name was already in use for another and prior publication so two attempts were made to correct this. One author called it *A. occidentalis* and another *A. smithii*. The former name was taken up for some time though it appears the latter really has the claim of priority; hence it is used here, though its author uses the other in the "Flora of Colorado."

hardly form tufts. It is entirely possible that it might be made more valuable if it were encouraged on the ranges it occupies. The two species named and *Agropyron arizonicum* give promise of being quite valuable where they will grow, if properly encouraged and cared for, but no such work has yet been done so far as we know.

The genus to which our cultivated barley belongs, (*Hordeum*), is represented in New Mexico by three very easily distinguished species, the third one in our list being probably a recent introduction as a weed in the fields at the southern end of the State. As yet it is of little importance but it may get to be a pest in the irrigated lands.

SQUIRREL-TAIL GRASS (*Hordeum jubatum*) is one of the commonest of ditch-bank weeds, especially at the higher levels in the mountains, but not infrequently found along the ditches or in the fields in the lower irrigated valleys, the seeds having come down on the river waters and having been deflected into the lateral ditches and distributed to the fields. Its name is suggestive of its most pronounced characteristics, though it is not infrequent to hear it called "fox-tail grass." (The latter name should be reserved for the species of *Chactochloa* referred to previously. They resemble Italian millet somewhat.) It is a tufted or "bunch" grass of a bright yellowish green, with numerous erect stems about a foot high and conspicuously long bearded heads. It is of little or no value as a forage plant but is a pretty aggressive weed in some places. It is apt to get into alfalfa fields at the middle levels where the summer is moderately cool and is considerable of a nuisance. Its profusion of light seeds that float readily on the irrigation water and its habit of growing beside streams in the mountains make this method of seed dissemination most effective and at the same time hard for the farmer to combat.

Hordeum nodosum sometimes called Wild or Meadow Barley is a small grass found only at high levels in the mountains, usually on high peaks or in wet meadows. In the latter situation associated with sedges, rushes and other grasses

which love such a cool habitat; it is used for pasture or cut for hay. This grass is small and tender, stools very little, is generally less than a foot high with small spike-like brownish-green panicle and short awns. It is never conspicuous nor very abundant and is consequently of little economic importance in New Mexico.

PERENNIAL RYE GRASS (*Lolium perenne*) is an introduced species, the seeds of which may be had from the seedsmen. Its value as a meadow grass has not been thoroughly tested but it would seem to be promising for the higher levels, especially in mountain meadows. It has been grown with some success at various places and has occasionally escaped from cultivation, a fact that is quite suggestive. Grown in the lower irrigated valleys it does not do well with muddy water and the summers seem to be too hot for it. But there is little reason to try such grasses in these locations for the land is entirely too valuable for other purposes and alfalfa will produce more hay several times over, in such localities, than any grass. In cool meadows where the water is clear this grass should be valuable associated with other grasses that delight in such climatic conditions.

WILD RYE (*Elymus canadensis*) is a tall coarse grass sometimes $4\frac{1}{2}$ to 5 feet tall, that grows in the mountains in the timbered and wooded areas. It also frequently occurs along the ditches and fence rows in the irrigated valleys, occasionally tolerably abundant. It is a grass that lends itself to cultivation and would grow with Sacaton and Johnson Grass and form fairly good coarse hay. It would require less irrigation than alfalfa and with Sacaton could be grown on land that received flood waters only. Mr. J. K. Metcalfe grew it successfully for a number of years at his ranch near Silver City along with the next species (*E. robustus*) which may be little more than a stouter and more hairy form of this species.

One of the commonest grasses of the hotter and drier parts of the mountains and to some extent on the plains is

Sitanion longifolium, a grass that so far as we know has received no common name. As used here the name given above is intended to cover what Mr. J. G. Smith believed to be two species, one of which he called *S. longifolium* and the other *S. brevifolium*. We are unable to separate them in any way but arbitrarily, though extreme forms would seem distinct enough. Possibly further study will show that Mr. Smith was correct. The grass in question is a tufted perennial from 8 to 15 inches high, depending upon the amount of water it gets. Its stems are erect; there are several from a root, each terminated by a head which roughly resembles a head of bearded wheat, with unusually small grains. In very dry situations the grass has a grayish color due to the "bloom" on the leaves and stems. Where it receives more water it is greener. When mature the awns or "beards" are widely spreading and the small branches of the panicle break up, setting free the whole spikelet instead of merely the mature grain as is common in most of the grasses.

It is probable that *Sitanion pubiflorum* is much more common in the State than is indicated by the collections, but has been confused with the preceding and not collected. It has been the custom to consider all the species of the genus but forms of an extremely variable species and refer all of them to a single species and make few collections. None of these grasses are very important as forage plants since stock do not seem to care much for them. The other two species here listed are rare in the western side of the State which they enter from Arizona.

Tribe IX. HORDEAE.

Spikelets usually single at the nodes of the rachis. (Compare *Hordeum*.)

Empty glumes with their sides turned toward the rachis.

68. AGROPYRON.

Empty glumes with their backs turned toward the rachis. A single species.

70. LOLIUM.

Spikelets 2 to 6 at each joint of the rachis, or if solitary the empty glumes arranged obliquely to the rachis.

Spikelets 1-flowered or with a rudimentary second flower.

69. HORDEUM.



SQUIRREL-TAIL GRASS. (*Hordeum jubatum*.)



WILD RYE. (*Elymus robustus.*)

Spikelets 2-to many-flowered.

Rachis of the spikes jointed, readily breaking into joints.

72. *SITANION*.

Rachis of the spikes continuous, not breaking at the joints.

71. *ELYMUS*.

Triticum repens has been reported from two localities in New Mexico by Rothrock but we have not seen specimens.

68. *AGROPYRON* Gaertn. WHEAT GRASSES.

Rachis of the spike breaking up at maturity, the joints falling with the spikelet.

1. *A. scribneri*.

Rachis of the spike continuous.

Awns of the flowering glumes conspicuous.

Awns divergent.

Spikelets subterete, i. e. nearly cylindric, more or less crowded.

2. *A. bakeri*.

Spikelets flattened, not crowded.

Leaves rough hairy (scabrous-pubescent) above; empty glumes acute or obtuse.

3. *A. arizonicum*.

Leaves smooth, not hairy; empty glumes acuminate or awn-pointed.

4. *A. spicatum*.

Awns erect, not divergent.

Awns short, sometimes wanting; spike mostly purple tinged.

6. *A. violaceum*.

Awns longer, usually longer than the body of the flowering glume.

Stems stout: spike 7 to 10 mm. wide, erect but usually one-sided; spikelets (excluding the awns) 12 to 15 mm. long.

6. *A. richardsonii*.

Stems slender; spikes about 5 mm. wide, usually nodding, seldom one-sided; spikelets (including the awns) about 10 mm. long.

7. *A. caninum*.

Awns of the flowering glumes not conspicuous.

Plants bright green, not glaucous.

8. *A. tenerum*.

Plants conspicuously glaucous.

Sheaths and flowering glumes at most, scabrous.

9. *A. smithii*.

Sheaths and flowering glumes noticeably pubescent.

10. *A. palmieri*.

1. *Agropyron scribneri* Vasey. Known in New Mexico from one specimen from the top of the Las Vegas range. On high mountains in the Hudsonian and Arctic-alpine Zones.

2. *Agropyron bakeri* E. Nelson. Also on high peaks in the Hudsonian Zone.

3. *Agropyron arizonicum* S. and S. In the mountains of the southern part of the State in the Transition Zone.

4. *Agropyron spicatum* (Pursh) Rydb. In the mountains of the southern part of the State; in the Upper Sonoran Zone.

5. *Agropyron violaceum* (Hor.) Vasey. From the high mountain peaks throughout the State in the Hudsonian and Arctic-alpine Zones.

6. *Agropyron richardsonii* (Trin.) Schrad. In the mountains of the northern part of the State; in the Canadian Zone; rare.

7. *Agropyron caninum* (L.) Beauv. Known in New Mexico from a single collection on Truchas Peak.

8. *Agropyron tenerum* Vasey. As here used this name includes the common wheat grass of the timbered areas in our mountains. We are unable to separate *A. pseudo-repens* S. and S. from this. The species occurs in the Transition and Canadian Zones.

9. *Agropyron smithii*. COLORADO BLUE-STEM. This is one of the commonest grasses of the Transition Zone throughout the State, reaching downward into the Upper Sonoran.

10. *Agropyron palmeri* (S. and S.) Rydb. Closely resembling the last and having much the same distribution.

69. HORDEUM L. BARLEY.

Plants not glaucous.

Empty glumes (including the awns) 1 to 2 inches long; spikes bright yellowish green.

1. *H. jubatum*.

Empty glumes (including the awns) less than 3-4 of an inch long; spikes dull reddish or brownish green.

2. *H. nodosum*.

Plants glaucous throughout; introduced weed.

3. *H. murinum*.

1. *Hordeum jubatum* L. SQUIRREL-TAIL GRASS. Sometimes incorrectly called Fox-tail. Common in wet soil in the mountains in the Transition Zone and frequently carried lower along irrigating ditches and streams.

2. *Hordeum nodosum* L. In high mountain meadows in wet soil; in the Canadian and Hudsonian Zones.

3. *Hordeum murinum* L. A species probably recently introduced in the cultivated fields of the southern part of the State.

70. **LOLIUM** L. PERENNIAL RYE GRASS.

1. **Lolium perenne** L. PERENNIAL RYE GRASS has been tried as a pasture grass in a number of places and has done fairly well in the cooler mountains where it had enough water. Escaped in such situations. It does poorly under cultivation in the lower valleys.

71. **ELYMUS** L. WILD RYE.

Flowering glumes awnless or with a very short awn; empty glumes very narrow, awl-shaped; flowering glume broadly lanceolate, smooth.

Flowering glume long awned; empty glumes lanceolate or narrowly lanceolate, narrowed at the base.

Spike narrow; spikelets erect.

Leaves broad, 7 to 15 mm., spreading; empty glumes lanceolate; awns short.

Leaves narrow, 5 mm. or less, usually nearly erect; empty glumes narrowly lanceolate; awns long.

Spike broad; spikelets spreading.

Flowering glumes glabrous.

Flowering glumes pubescent.

Flowering glumes hirsute or villous.

Flowering glumes strigose-hispidulous or scabrous; plant taller; leaves wider; spike larger.

1. *E. triticoides*.

2. *E. glaucus*.

3. *E. macounii*.

4. *E. brachystachys*.

5. *E. canadensis*.

6. *E. robustus*.

1. **Elymus triticoides** Nutt. Not common. Occurs in the mountains at higher levels. Canadian Zone.

2. **Elymus glaucus** Buckl. In the mountains of the northern part of the State; in the Transition Zone.

3. **Elymus macounii** Vasey. A single specimen collected at Albuquerque is all we have seen from New Mexico.

4. **Elymus brachystachys** Scrib. and Ball. Rare in the State: only one collection that we are sure of.

5. **Elymus canadensis** L. WILD RYE. Common in the mountains at middle elevations in the Transition and Upper Sonoran Zones, but also occurring on ditch banks in the cultivated areas of the Lower Sonoran Zone.

6. **Elymus robustus** S. and S. Very similar to the last; in cultivation at Mangas Springs.

72. **SITANION** Raf.

Some of the empty glumes 2-cleft from about the middle, lobes abruptly divergent.
Sheaths not villous.

1. *S. caespitosum*.

2. *S. molle*.

Sheaths conspicuously villous.
Empty glumes all entire, awl shaped.

Flowering glumes about 7 mm. long, soft pubescent.

2. *S. pubiflorum*.

Flowering glumes glabrous about 10 mm. long.

4. *S. longifolium*.

1. **Sitanion caespitosum** J. G. Smith. Known only from the type locality in southwestern New Mexico in the Upper Sonoran Zone.

2. **Sitanion molle** J. G. Smith. In the mountains of the west central part of the State in the Transition Zone.

3. **Sitanion pubiflorum** J. G. Smith. On the high plains and in the foothills of the mountains at various places throughout the State. It is probably tolerably common but has been overlooked: in the Upper Sonoran Zone.

4. **Sitanion longifolium** J. G. Smith. As used here this covers both the species named and *S. brevifolium* of the same author which would seem to be hardly sufficiently distinct. They form the bulk of what older authors called *Elymus sitanion* and *Sitanion elymoides*. The species is common everywhere throughout the State in arroyos, foothills and the drier parts of the mountains in the Sonoran Zones and occasionally in the Transition.

The Sedge Family (CYPERACEAE) contains those plants mostly known as Sedges and, as well, has a number of other species in it that go under the name of Spike Rush, or Bull Rush or various other kinds of rushes but do not belong with the true rushes (Junaceae) considered farther on. The Cyperaceae are most nearly like grasses except for the differences given below, and many of them superficially appear much like grasses. Grasses have their leaves arranged in two rows (2-ranked) up and down the stem while the sedges have them in three. The grasses have the sheaths open at

the margin, the stems hollow, and the fruit a grain. The sedges have the sheaths closed, completely surrounding the stem, the stems are solid and the fruit is an achene. Practically all the grasses we have in New Mexico have leaves that are easily recognized as leaves while many of the Cyperaceae have the leaves reduced to sheaths without any blade and these hardly reaching above the surface of the ground.

Many of the sedges and their allies grow only in wet soils—in the mud beside streams or springs, on the edges of the ditches with their roots in the water, in boggy places, in the saturated soils of the mountain meadows and cienagas. Many of them will endure much alkali in the soil if there be plenty of water and nearly all of them are restricted little or not at all by the climatic differences of the different zones, ranging all the way from the Lower Sonoran up to and through the Transition Zones.

The different genera differ among themselves as is indicated in the key and list following.

CYPERUS Two species of *Cyperus*, *C. rusby* and *C. fendlerianus*, occur in the timbered parts of the mountains and to some extent on the higher plains and will at once be called grasses by the careless observer. They may be recognized by their triangular stems and the group of leaves surrounding the panicles of flowers. These plants though never forming a sod are an important part of the forage crop of such regions and are eaten freely by the stock of all kinds. They are perennials and hence are part of the permanent forage crop for such regions. ffl

NUT GRASS (*Cyperus esculentus*) and *C. erythrorhizos* and *C. speciosus*, both of which closely resemble Nut Grass in a general way, occur as weeds in the cultivated fields, and especially in lands subject to flooding. They are introduced species and the Nut Grass is getting to be pretty widely distributed.

Cladium jamaicense is a tall reed-like sedge with

coarse, rough, grass-like leaves and a large panicle of small but numerous spikelets (blackish green), that grows in wet bottoms in the Pecos Valley near Roswell. It may occur in the tule swamps at other places, but has not been collected. It is of no value as forage.

THE SPIKE RUSHES (*Eleocharis* spp.) are small plants with single, slender, cylindric or slightly flattened stems from one or two inches to a foot high, terminated by a single small, brown or yellow spikelet without any subtending leaves or bracts; and the proper leaves reduced to a short sheath at the base, which hardly comes above the surface of the ground. They usually form a thick sod of small area on saturated soil beside bog holes, springs, small streams or in the cienagas. They add a little to the forage, but it is of slight importance. The species look very much alike and the characters by which they are differentiated are such as one usually needs a lens to see.

Stenophyllus and *Hemicarpha* are included only for completeness as there is never enough of them to be of value economically. Both are small plants rarely over six inches high and grass-like in appearance.

THE BULL RUSH (*Scirpus occidentalis*) is easily recognized by its tall, bluish-green stems the size of a lead pencil, with the yellowish brown panicle at the top, as they grow in bogs and drowned flats wherever the water stands all the time, associated with Cat Tails and other reeds and rushes. Other and smaller species with triangular stems found in similar situations are *S. olneyi*, *S. americanus*, and *S. campestris*, the latter with several flat leaves as bracts about the panicle. *S. microcarpus* and *S. atrovirens* are coarse leafy rushes growing in the water beside streams in the mountains at medium to moderately high levels, where the soil and water are not very alkaline and the air rather cool. All of these plants are eaten more or less by stock, though in the main they grow where the animals have difficulty in getting at them. They are not very valuable economically.

THE SEDGES (*Carex* spp.). This is without question the largest genus of plants known and is distributed all over the world. Our State has comparatively few of them, as is to be expected, for they are plants that love a water soaked soil. Thirty-two species of the genus are here listed and there are probably more, since collectors almost invariably pass them over, because the species are hard to recognize. They are all quite grass-like in appearance, from a few inches to a foot or more tall, and grow mostly in wet soil beside streams, along ditch banks, in boggy spots at springs and in the cienagas. The "grass" or hay of most of the mountain cienagas is made up of a mixture of a few of the true grasses that grow in water, many of the Rushes (*Juncus* spp.), the Spike Rushes (*Eleocharis* spp.), species of *Scirpus* and an occasional *Cyperus*, with a considerable sprinkling of Sedges (*Carex* spp.). The hay cut from such places is really quite valuable as winter feed and for farm animals that must be worked, although as compared with alfalfa or clover it is not very good hay. But alfalfa is very hard to get in such situations and is expensive, hence a product of the region is quite valuable as a usable substitute for an expensive product. These conditions obtain at many of the "headquarters" ranches of the cattle and sheep companies and the crop of the nearby cienaga or swale is utilized in this way. Many small farmers in the higher mountains have meadows in the heads of the small valleys, where the crop is similar to that of the cienagas. These form a natural summer pasture or produce a hay crop, for both of which purposes they can be and are often used.

Practically all of the species of *Carex* here listed are to be found in some such position, except those that grow only on the high mountain peaks above timber line. And it is probable that many of them will be found in the high cold meadows at the heads of mountain streams when those areas have been more carefully explored by collectors and more attention paid to the collecting of sedges. None of the

species here listed are important above all the others on account of abundance or other special quality. Probably the most common is *Carex maricida* which is widely distributed in the State but nowhere very abundant.

II. CYPERACEAE. THE SEDGE FAMILY

Grass-like or rush-like herbs with stems, some of them with perennial underground stems. Stems solid (rarely hollow), triangular, quadrangular, cylindric or flattened, leafy or leaves all basal. Leaves all 3-ranked with closed sheaths and narrow blade, sometimes much reduced. Flowers perfect or unisexual arranged in spikelets, one (or rarely 2) in the axil of each glume or scale; the spikelets solitary or clustered 1- to many-flowered. Glumes in 2 rows or spirally overlapping, persistent or deciduous. Perianth of bristles or scale-like parts, sometimes calyx-like, or wanting. Stamens 1 to 3, rarely more. Pistil of 2 or 3 united carpels. Fruit a lenticular or triangular achene.

Flowers of the spikelets, at least one of them, perfect, i. e. having both stamens and pistils.

Glumes of the spikelet enclosing a single bract.

Glumes of the spikelet not enclosing a bractlet.

Spikelets perfect, or mainly so.

Glumes of the spikelet 2-ranked; spikelets several-flowered; perianth wanting.

Glumes of the spikelet spirally arranged and overlapping; spikelets mostly several-flowered; perianth present (wanting in *Stenophyllus*.)

Base of the style not at all or only slightly thickened, deciduous.

Base of style manifestly swollen, persistent as a tubercle on the fruit.

Perianth present, a series of slender barbed bristles; spikelets solitary.

Perianth wanting; spikelets in an umbel.

Spikelets of both perfect and unisexual flowers.

Glumes of the spikelets spirally overlapping, plant large with compound umbels of small spikelets.

Flowers of the spikelets all unisexual, either monoecious or dioecious; achene enclosed in a hardened coat (perigynium.)

6. HEMICARPHA.

1. CYPERUS.

5. SCIRPUS.

3. ELEOCHARIS.

4. STENOPHYLLUS.

2. CLADIUM.

7. CAREX.

1. CYPERUS L.

Tufted or single stemmed, annual or perennial grass-like herbs 15 inches high or less, with basal leaves, triangular stems, and flowers in head-like clusters or unequally branched umbels subtended by one or more leaf-like bracts; spikelets flattened or cylindric glumes deciduous or if persistent the spikelets falling entire; glumes 2-ranked; flowers perfect; perianth none; stamens 1 to 3; achene without a tubercle.

Plants small, 2 to 6 inches high, annual; tips of bracts subulate, conspicuously reflexed, inflorescence capitate.

Plants much taller than 6 inches, perennial (rarely annual); tips of bracts mostly erect, sometimes spreading.

Spikelets ovate to ovate-oblong, 4 to 5 mm. long, crowded at the ends of the rather long subequal rays of the umbel.

Spikelets linear to narrowly oblong.

Spikelets narrowly oblong; scales of the flowers not overlapping, especially in fruit, very strongly nerved.

Inflorescence a compound umbel with unequal rays.

Inflorescence crowded, subcapitate.

Spikelets linear; scales of the flowers overlapping from one-half to two-thirds their length.

Spikelets deciduous as a whole when mature.

Spikelets with few, usually 2 or 3 flowers.

Spikelets with 6 to 9 flowers.

Scales of spikelets falling away from the rachilla.

Rachilla narrowly winged, the wings adnate, plants stout, stoloniferous; spikelets loosely clustered.

Wings of the rachilla not adnate, forming scales anterior to the flower.

Spikelets densely crowded; flowers numerous, about 20 to the spikelet; scales of the flower not bordered with red; plant stout.

Spikelets fewer, loosely clustered; flowers 12 or less; scales red-margined; plant slender.

1. *C. inflexus*.

2. *C. cyrtolepsis*.

3. *C. rusbyi*.

4. *C. fendlerianus*.

5. *C. uniflorus*.

6. *C. speciosus*.

7. *C. esculentus*.

8. *C. erythrorhizos*.

9. *C. sphacelatus*.

1. *Cyperus inflexus* Muhl. In the mountains of the south-
ern and southwestern part of the State; in the Upper Sonoran
Zone.

2. *Cyperus cyrtolepis* Torr. and Hook. Uncertainly New Mexican but occurring both east and west of us.

3. *Cyperus rusbyi* Britton. One of our commonest and most important species; in the mountains almost throughout the State; in the Upper Sonoran and Transition Zones.

4. *Cyperus fendlerianus* Boeckl. Common in the mountains throughout the State; in the Upper Sonoran and Transition Zones.

5. *Cyperus uniflorus* Torr. and Hook. Not common; comes in from Texas; in the Upper Sonoran Zone.

6. *Cyperus speciosus* Vahl. An introduced weed in cultivated lands, not yet common; in the Sonoran Zones.

7. *Cyperus esculentus* L. Nut Grass. Another introduced weed in cultivated valleys at the lower levels though also occurring higher up; not zonally restricted.

8. *Cyperus erythrorhizos* Muhl. Also an introduced weed, known as yet only from the Mesilla Valley but probably fairly common in other cultivated and irrigated valleys.

A few other species have been referred to New Mexico which probably do not come into the State. The mistakes are due to incorrect determination of species or to the incomplete character of some of the labels of the older collections.

2. CLADIUM R. Br.

Coarse perennial leafy herbs with cylindric stems, 4 to 5 feet tall; spikelets small, in large many-branched terminal panicles; glumes overlapping, the lower empty, the middle with unisexual flowers, the upper ones with perfect flowers; perianth none; stamens 2 or 3; style not persistent; achene ovoid to globose, smooth or ridged lengthwise

1. *Cladium pamaicense* Crantz. A tall reed-like sedge growing in water. Collected twice in the Pecos Valley near Roswell, which is its most western extension of range.

3. **ELEOCHARIS** R. Br. SPIKE RUSH.

Annual or perennial scapose herbs 6 inches to a foot high, with leaves reduced to basal sheaths, and solitary terminal spikes without subtending bracts; stems cylindric, flattened or angular, grooved, erect and slender; spikelets small; glumes spirally overlapping; perianth of 1 to 12 bristles; stamens 2 or 3; base of style noticeably swelled and persistent as a tubercle on the lenticular or three-angled achene.

Style-branches 2.

Annual; bristles shorter than the achene; spikes oblong-cylindric; tubercle broad and low.

1. *E. engelmanni.*

Perennial by roostocks; bristles longer than the achene.

Plant stout; tubercle conic triangular.

2. *E. palustris.*

Plant slender; tubercle almost cylindrical.

3. *E. glaucescens.*

Style-branches 3.

Plant very small, 1 to 4 inches high; fruit obovoid oblong, with numerous longitudinal ridges and finer transverse ones.

Plants larger, 8 inches high or more.

6. *E. acicularis.*

Tubercle constricted at the base, clearly distinct from the achene; plant slender, with slender roostocks..

4. *E. montana.*

Tubercle apparently confluent with the achene, cylindric; plant stouter, not stoloniferous.

5. *E. rostellata.*

1. **Eleocharis engelmanni** Steud. Not common in New Mexico. Known from only two collections in the western part of the State in the mountains, probably beside streams.

2. **Eleocharis palustris** (L.) R. and S. In wet soil beside springs and streams and in cienagas. Not restricted to any life zone.

3. **Eleocharis glaucescens** (Willd.) In wet soil in the mountains in the Upper Sonoran and Transition Zones.

4. **Eleocharis montana** (H. B. K.) R. and S. The commonest species of Spike Rush in our range. Occurs in wet soil beside springs and water holes, in cienagas and along streams, hardly at all restricted in vertical distribution from the timbered forests down to the hottest valleys.

5. **Eleocharis rostellata** Torr. In wet soil at the lower levels of the southern part of the State; in the Lower Sonoran Zone.

6. *Eleocharis acicularis* (L.) R. and S. In wet soil in the mountains throughout the State. Not common. Upper Sonoran and Transition Zones.

4. *STENOPHYLLUS* Raf.

Small annual herbs, more or less grass like, about 6 inches high or less, with basal leaves and umbellate or head-like flower-clusters of small spikelets subtended by 1 to several bracts; flowers perfect; glumes overlapping, perianth none; stamens 2 or 3; style swollen at the base and persistent as in *Eleocharis*; achene 3-angled or lenticular.

Plants 3 to 8 inches tall.

Plants usually about 1 inch high.

1. *S. capillaris*.

2. *S. funckii*.

1. *Stenophyllus capillaris* (L.) Britt. In wet soil beside streams or seeps in the drier mountains of the southern part of the State; in the Upper Sonoran Zone.

2. *Stenophyllus funckii* (Steud.) Britt. A rare species, known in New Mexico from a single collection in the Mogollon Mountains.

5. *SCIRPUS* L. RUSHES.

Annual or perennial herbs, some small and grass-like, some tall (4 or even 5 feet) with reduced basal leaves or sheaths; spikelets cylindric or somewhat flattened with glumes spirally overlapping, in terminal clusters, single, head-like or umbellate, subtended by 1 to several bracts; flowers perfect; perianth of 1 to 6 slender bristles (rarely none); stamens 2 or 3; style not swollen at the base; achene triangular or lenticular.

Involucral bracts 1 or 2 or none.

*Spikelets solitary, terminal; involucral bracts none.

1. *S. pauciflorus*.

Spikelets several, seemingly lateral; involucral bracts 1 or 2.

Culms terete; involucral bracts 2, shorter than the subumbellate inflorescence.

5. *S. occidentalis*.

Culms triangular; involueral bract 1, seeming to be a prolongation of the culm.

Involueral bract short, about 1 inch long or less, barely exceeding the spikelets which are generally 4 to 6 and crowded; leaves about one-fifth the length of the culm.

2. *S. olneyi*.

Involueral bract 1 1-2 to 4 inches long, much exceeding the spikelets which are few in number, frequently only 1, and small; leaves half as long to almost as long as the culms.

3. *S. americanus*.

Involueral bracts of several flat leaves which much exceed the compound umbellate inflorescence.

Culms triangular; spikelets large, 10 to 20 mm. long, light yellowish brown; inflorescence a simple umbel or in young plants capitate.

4. *S. campestris*.

Culms terete; spikelets small, 2 to 7 mm. long, greenish; inflorescence a once or twice compound umbellate cluster with unequal and numerous rays.

Style branches 2; akenes rounded on the back; inflorescence twice compound; spikelets not capitate.

6. *S. microcarpus*.

Style branches 3; akenes angled on the back; inflorescence generally once (sometimes twice) compound spikelets densely capitate at the ends of the rays.

7. *S. atrovirens*.

1. *Scirpus pauciflorus* Lightf. Probably not uncommon in the mountains. Only one collection seen. In wet soil.

2. *Scirpus olneyi* A. Gray. In wet alkaline soil beside springs, water holes and streams; in the Upper Sonoran Zone.

3. *Scirpus americanus* Pers. In water soaked soils at various levels throughout the State; mainly in the Sonoran Zones.

4. *Scirpus campestris* Britton. (*Scirpus maritimus* of various authors not of Linnaeus.) In wet soil in the warmer parts of the State; in the Sonoran Zones.

5. *Scirpus occidentalis* (S. Wats.) Chase. BULL RUSH. In wet and boggy soil beside streams, water holes, cienagas, etc., mostly in the Sonoran Zones.

6. *Scirpus microcarpus* Presl. Beside streams and ditches and in cienagas in the mountains; in the Transition Zone.

7. *Scirpus atrovirens* Muhl. Collected but once in New Mexico near Pecos in the Upper Sonoran Zone.

6. HEMICARPHA Nees.

Low, tufted, mostly annual, grass-like herbs about 4 inches high or less, with erect or spreading slender leaves and small terminal head-like or solitary spikelets with 1 to 3 leaf-like bracts surrounding them and much exceeding them; glumes spirally overlapping, deciduous; perianth wanting; stamens 1; achene obovate-oblong, little compressed, brown.

1. *Hemicarpha micrantha* (Vahl) Britton. In wet soil beside streams, etc.; in the Sonoran Zones.

7. CAREX L. Sedge.

Perennial grass-like plants with 3-ranked leaves, mostly 3-angled culms; flowers unisexual, monoecious or dioecious; perianth wanting; stamens 3; pistillate flowers a single pistil with 2 or 3 stigmas, in a sack-like perigynium, this completely enclosing the achene; achenes 3-angled or lenticular.

A very large genus of which the following listed species probably represent only a part of those indigenous to New Mexico. Collectors rarely take the trouble to examine the plants unless their attention is particularly called to them. There are no doubt several species common in the high mountains at the northern part of the State which have not been collected.

Spikes terminal, usually simple (androgynous.)

Plants densely caespitose; leaves filiform, terete.

Plants stoloniferous; leaves linear-lanceolate, flat.

Spikes several, sometimes crowded.

Spikes aggregated into a single round or ovoid head.

Stigmas 3; scales purplish black.

Stigmas 2; scales brown, or green on the margins.

Perigynium ovate to suborbicular, rather light brown, green on the margin.

Perigynium lanceolate, dark brown and shining.

1. *C. filifolia.* ✓

2. *C. obtusata.* ✓

23. *C. nova.* ✓

12. *C. festiva.* ✓

13. *C. ebenea.* ✓

Some or all of the spikes distinct.

Inflorescence merely interruptedly spicate or paniculate.

Inflorescence of several small spikelets sessile upon the central peduncle, forming a compound spike.

Inflorescence slender, 5 mm. wide or less, interrupted.

Spikes 1- to 3-flowered; perigynia ellipsoidal, erect; beak very short.

16. *C. tenella*. ✓

Spikes 4- to 8-flowered; perigynia ovate-lanceolate, divergent; beak 1-4 as long as the perigynium.

17. *C. interior*. ✓

Inflorescence denser, 5 to 10 mm. wide, not appreciably interrupted.

Perigynia lanceolate, acuminate into a long beak, strongly nerved.

11. *C. stipata*. ✓

Perigynia ovate, abruptly short-beaked, weakly nerved.

Spikes with 1 to 5 perigynia, the latter 4 mm. long, not concealed by the whitish scales.

10. *C. neomexicana*. ✓

Spikes with 5 to 10 perigynia, the latter 2.5 to 3.5 mm. long, mostly concealed by the brownish scales.

9. *C. occidentalis*. ✓

Inflorescence of larger, ascending or spreading spikes.

Lower spikes pedunculate.

7. *C. agrostoides*. ✓

Lower spikes not pedunculate.

Spikes crowded at the top of the peduncle.

Terminal spikes staminate.

26. *C. pennsylvanica*.

Spikes all containing flowers of both sexes.

Plants low, 4 to 6 inches high; spikes narrowly ovate-lanceolate.

3. *C. douglasii*.

Plants tall, 15 to 30 inches high; spikes broadly ovate to orbicular.

15. *C. tribuloides*. ✓

Spikes scattered along the peduncle.

Perigynia narrowly wing-margined.

Beak bidentate, perigynia brown.

14. *C. liddoni*.

Beak not bidentate, oblique.

8. *C. siccata*. ✓

Perigynia not wing-margined.

Perigynia abruptly contracted into a short beak, about 1-5 the length of the body.

4. *C. simulata*. ✓

Perigynia tapering into a beak 1-2 the length of the body or more.

Perigynia not conspicuous, few in each spike; scales straw-colored.

6. *C. latebrosa*. ✓

Perigynia conspicuous, about 10 in each spike; scales brown.

5. *C. marcida*. ✓

Inflorescence of 2 to several distinct spikes.

Terminal spikes not staminate; scales black.

Spikes 5 to 7 mm. long; peduncles less than 1 cm. long.

22. *C. alpina*.

Spikes 10 to 15 mm. long; peduncles 1 to 5 cm. long.

24. *C. bella*. ✓

Terminal spike staminate; scales variously colored (black in one section).

Plants small, less than 1 foot high; spikes short, 15 mm. long or less, loosely few-flowered.

Perigynia obovate, obtuse, strongly many-nerved, not beaked.

Perigynia lanceolate, acuminate into a beak, few-nerved.

Plants taller, 1 to 3 feet high; pistillate spikes 3-4 to 5 inches long, densely many-flowered, cylindric.

Pistillate spikes 3-4 to 1 1-2 inches long.

Perigynia pubescent.

Perigynia glabrous.

Scales green or brown.

Perigynia lanceolate, 5 to 7 mm. long, long-beaked, strongly divaricate; scales greenish.

Perigynia broadly ovate, 4 mm. long or less, short-beaked, not so strongly divaricate; scales brown.

Scales purplish black.

Spikes sessile.

Spikes pedunculate.

Mature perigynia yellowish-brown, not nerved.

Mature perigynia dark chestnut brown, several-nerved.

At least some of the pistillate spikes 1 1-2 to 5 inches long.

Scales long acuminate; perigynia elliptic, nerveless, dull-colored, with minute reddish-brown dots.

Scales obtuse or merely acute.

Fruiting spikes 6 to 8 mm. broad; perigynia inflated, shining, yellow, nerved; beak conspicuous.

Fruiting spike 3 mm. broad; perigynia flattened, dull, greenish, nerveless; beak very short.

27. *C. aurea*.

28. *C. capillaris elongata*.

31. *C. lanuginosa*.

29. *C. hystricina*.

32. *C. saxatilis*.

19. *C. vulgaris*.

18. *C. variabilis*.

20. *C. nebraskensis*.

25. *C. ultra*.

30. *C. utriculata*.

21. *C.*

✓ 1. *Carex filifolia* Nutt. In the foothills of the higher mountains; in the Upper Sonoran Zone.

✓ 2. *Carex obtusata* Lilj. An uncommon species found in the higher mountains; in the Transition Zone.

✓ 3. *Carex douglasii* Boott. Fairly common in the higher mountains of the northern part of the State; in the Transition Zone.

✓ 4. *Carex simulata* Mackenzie. Reported but once on the strength of one of Fendler's specimens (No. 881), from about Santa Fe probably.

✓ 5. *Carex marcida* Boott. Common in wet soil beside springs and streams, in cienagas, etc.; not zonally restricted.

✓ 6. *Carex latebrosa* Mackenzie. In similar situations to the last; in the Upper Sonoran Zone.

✓ 7. *Carex agrostoides* Mackenzie. Similar in general appearance to No. 5; in the Transition Zone in the mountains of the western part of the State.

✓ 8. *Carex siccata* Dewey. On the high mountain peaks in the Arctic-alpine Zone.

✓ 9. *Carex occidentalis* Bailey. In the timber covered mountains; in the Transition Zone. Fairly common.

✓ 10. *Carex neomexicana* Mackenzie. Not common; in the drier mountains; in the Upper Sonoran Zone.

✓ 11. *Carex stipata* Muhl. In the timbered mountains. Not common; in the Transition Zone.

✓ 12. *Carex festiva* Dewey. In the timber covered mountains; in the Transition Zone. Not common. *By the Mt. Mans.*

✓ 13. *Carex ebenea* Rydb. On the high mountain peaks in the northern part of the State; in the Arctic-alpine Zone.

✓ 14. *Carex liddoni* Boott. In the mountains of the southern third of the State in the Transition and Canadian Zones.

✓ 15. *Carex tribuloides* Wahl. Collected once on the upper branches of the Gila in the Mogollon Mountains.

✓ 16. *Carex tenella* Schkuhr. Known in New Mexico only from Santa Fe Canon. Probably fairly common along streams in the higher mountains of the northern part of the State.

✓ 17. *Carex interior* Bailey. In the mountains of the northern part of the State; in the Transition Zone.

✓ 18. *Carex variabilis* Bailey. In the higher mountains at the northern end of the State; in the Arctic-alpine Zone.

19. *Carex vulgaris* Fries. In the higher mountains about timber line; in the Hudsonian Zone.

✓ 20. *Carex nebraskensis praevia* Bailey. In the foothills in wet soil beside streams; near the top of the Upper Sonoran Zone.

✓ 21. *Carex ~~emarginata~~ new sp.* Ditch banks in the Mesilla Valley. *Dewey*

22. *Carex alpina* Swartz. In the mountains from timber line upward; in the Hudsonian and Arctic-alpine Zones. ✓
23. *Carex nova* Bailey. On the high mountains with the last; in the Hudsonian and Arctic-alpine Zones. ✓
24. *Carex bella* Bailey. On high mountains near timber line; in the Hudsonian Zone. ✓
25. *Carex ultra* Bailey. A single collection from the extreme southwestern corner of the State. ✓
26. *Carex pennsylvanica* Lam. One specimen from near Las Vegas. It is probably common on the high mesas at the northern end of the State, but has not been collected. ✓
27. *Carex aurea* Nutt. In the mountains of the northern part of the State; in the Transition and Canadian Zones. ✓
28. *Carex capillaris elongata* Olney. On high cool mountains in the northern part of the State; in the Arctic-alpine and Hudsonian Zones. ✓
29. *Carex hystericina* Muhl. In the mountains of the southwestern quarter of the State; in the Transition Zone (?). ✓
30. *Carex utriculata* Boott. In boggy places in the mountains; in the Transition Zone. = *rostrata* 'det. Tuck.' ✓
31. *Carex lanuginosa* Michx. In wet soil beside springs and streams, in cienagas, etc. in the mountains; in the Transition Zone. ✓
32. *Carex saxatilis* L. Known in New Mexico only from Truchas Peak at 12000 feet altitude; in the Arctic-alpine Zone. ✓

Several other species have been reported from the State but we were unable to identify them, and saw no material.

The Rushes (JUNCACEAE) are grass-like plants which are called grasses by almost every one except the botanist, and economically they are treated as grasses are. The structure of the flower of the grasses has already been explained and illustrated and it is only necessary to say that the flowers of the rushes have 3 petals, 3 sepals, 3 or 6 stamens,

and usually a 3-celled dry pod with few to several seeds in each cell. The petals and sepals are chaffy and small; they are never conspicuously colored, being brown or greenish or dull yellowish; the stems are slender, not hollow like grasses, and never very tall; and the leaves are narrow and grass-like. The plants live mostly in situations similar to those occupied by grasses though most of them prefer places where there is an abundance of water, thus forming a large part of the vegetation of the open cienagas and boggy places or wet meadows that are found occasionally in the mountains, especially at the higher levels. Several of the species are found on the tops of the higher mountain peaks above timber line. Naturally these last named species are of little economic importance in New Mexico for very few animals ever go up to such places even in the middle of the summer.

Those species which grow in the wet open mountain valleys or meadows and in the cienagas are usually of considerable importance, since the owners of the land (and land where there is abundance of water is nearly all owned in New Mexico) have in most cases fenced these areas and cut the "grass" for hay to be used either in feeding stock necessarily kept up in the corrals or stables about the ranch, or in feeding during periods of scarcity, especially in the winter. Occasionally the hay produced is baled and sold, particularly in mining camps or other places remote from the railroads connecting easily with the alfalfa producing valleys.

The hay produced from such plants is never very good as feed, and stock accustomed to eating alfalfa will hardly eat it. It is partly composed of the true grasses (those species which do best in very wet or practically saturated soil being more or less common) and a larger or smaller proportion of rushes, the amount of the latter usually depending upon the water content of the soil. In situations where the ground is saturated and sometimes flooded, the rushes do best and are more abundant especially if the altitude is great and the region correspondingly cool. Where the conditions are re-

versed, i. e., the soil drier and the temperature higher, there is a correspondingly larger proportion of grasses present in the hay. Work stock accustomed to alfalfa eat any of the resulting hay very poorly and select the grass as the less objectionable, refusing the rushes until they are very hungry. Stock accustomed to it eat it much more freely. Data as to its actual feeding value have not yet been obtained, but it is probably something like corn stover or quite possibly not so good.

There are eighteen or possibly more species of the rushes found growing in the State and they belong to two genera that may be distinguished by the leaves. In one genus (*Juncoides*) the base of the leaf forms a completely enclosing sheath fitting as a hollow tube all around the stem. Three species of this genus all having flat grass-like green leaves are to be found mostly above the timber line on the high peaks of the northern end of the State. The other genus (*Juncus*) has leaves in which the sheaths are merely clasping, but the edges not grown together so as to form a tube. This is the more common genus and several of its species are those already mentioned as being of some, though not of very great economic importance. Of the fifteen species here listed a little more than half are to be found growing where they add somewhat to the forage crop, numbers 2, 3, 6, 7, 13, and 15 being the most abundant and important. Of these, numbers 3 and 15 are most common at lower levels in boggy or moist places or beside seeps and small streams in the hotter and drier mountains and number 3 sometimes occurs on the lower plains where the soil is dry. The others are nowhere common below 6000 to 6500 feet and occur most frequently at from 8000 to 9000 feet elevation.

There are no distinctive common names for the species; in fact very few individuals recognize them as being in any way different from grasses. Almost all of them are perennials, 18 inches (or rarely up to 2 feet) high or less, mostly forming tufts of smooth, tough, green stems, without joints;

some of them have leaves and in some the leaves are reduced to basal scales. Sometimes the leaves are more or less cylindrical and hollow and again they are flattened and seem to be divided crosswise into sections (septate), or they may be arranged in pairs, the base of the outer and upper one enclosing or straddling over that of the next one below (equitant). The family is a large one, but not to be compared in any way with the true grasses.

III. JUNCACEAE RUSHES

KEY TO THE GENERA.

- | | |
|--|---------------|
| Leaf-sheaths open; capsules 1- or 3-celled;
seeds many. | 1. JUNCUS. |
| Leaf-sheaths closed; capsules always 1-celled;
seeds 3. | 2. JUNCOIDES. |

I. JUNCUS L. RUSHES.

Lower bracts of the inflorescence terete, erect, appearing as a prolongation of the stem; inflorescence apparently lateral.

Flowers few, 1 to 5, of which 1 is subsessile and the others pedicelled.

1. *J. drummondii*.

Flowers several in a more or less compound panicle; seeds apiculate.

Plant slender; bract extending considerably beyond the inflorescence.

2. *J. balticus*.

Plant stouter; bracts extending little if any beyond the inflorescence.

3. *J. mexicanus*.

Lower bracts not appearing as a continuation of the stem, or if so, channeled on the upper surface; inflorescence terminal.

Leaves septate (septa sometimes poorly developed and hard to see in pressed material: compare numbers 9 and 10.)

Leaves terete, not equitant.

Inflorescence with short branches; flowers numerous, crowded, echinate-spreading; capsules narrowly lanceolate; heads at least some of them over 10 mm. in diameter.

4. *J. torreyi*.

Inflorescence of mostly solitary, small heads (sometimes 2 or 3); flowers fewer not echinate-spreading; capsules oblong; seeds usually caudate.

5. *J. mertensianus*.

Leaves equitant, laterally flattened with one edge towards the stem.

Flower clusters numerous, small, 5-12 flowered, generally light colored.

6. *J. brunescens*.

Flower clusters few, 15- 25-flowered, generally darker colored.

Perianth-segments green bordered, ligules usually not auricled.

Perianth-segments fuscous or very dark brown; ligules produced into small auricles.

Leaves neither septate nor equitant.

Leaves hollow; flowers few, in small heads.

Stem leafy only at the base, but the upper leaf often with a long sheath; perianth about 4 mm. long; lower bract of inflorescence membranous.

Stem more or less leafy; perianth 5 to 6 mm. long; lower bracts foliaceous.

Leaves not hollow; flowers numerous.

Flowers not bracteolate, in true heads on branches of the inflorescence; leaves broad and grass like.

Flowers bracteolate, inserted singly on the branches of the inflorescence; leaves narrowly linear, either flat or subterete and channeled.

Annual plants, quite small; stems branching.

Perennial plants, much larger; stems simple.

Auricles cartilaginous, yellowish-brown; bracts usually elongated much exceeding the inflorescence; perianth spreading.

Auricles scarious or membranous scarcely produced; bracts usually much shorter, hardly exceeding the inflorescence.

Perianth segments about equaling the capsule, 3 to 4 mm. long.

Perianth segments mostly exceeding the capsule, 4 to 5 mm. long.

7. *J. parous*.

8. *J. saximontanus*.

9. *J. triglumis*.

10. *J. castaneus*.

11. *J. longistyllis*.

12. *J. bufonius*.

13. *J. dudleyi*.

14. *J. interior*.

15. *J. arizonicus*.

A single specimen of *Juncus neo-mexicanus* Wieg. (determined by Wiegand) was collected by Dr. Palmer probably in extreme western New Mexico near Fort Defiance in 1869. It seems too near to *J. arizonicus*.

1. *Juncus drummondii* Mey. Above timber line on the high mountains in the northern part of the State: in the Arctic-alpine Zone.

2. *Juncus balticus* L. In the mountains at middle elevations in wet places and brought to lower levels occasionally by stream; in the Transition Zone mostly.

3. *Juncus mexicanus* Willd. On plains in wet soils in the southern part of the State at low levels. It will endure dryish and alkaline soils. In the Lower Sonoran Zone.

4. *Juncus torreyi* Coville. In bogs and cienagas and flooded river valleys of the lower parts of the State up to about 6000 feet altitude. In the Sonoran Zones.

5. *Juncus mertensianus* Bong. Known in New Mexico from a single collection at Spirit Lake at an elevation of about 10000 feet. Probably fairly common on high peaks in the northern part of the State; in the Arctic-alpine Zone.

6. *Juncus brunescens* Rydb. With the next, about the most common species of the State, found in the timber covered mountains at middle elevations (or sometimes lower) beside streams, seeps or in cienagas, in the Transition Zone.

7. *Juncus parous* Rydb. Commonly with the preceding having the same altitudinal and geographic range; often confused with it.

8. *Juncus saximontanus* A. Nels. Rare in our range; found only in the northern part of the State; in the Transition Zone. Easily confused with the preceding.

9. *Juncus triglumis* L. An Arctic-alpine species known in New Mexico from a single collection on Truchas Peak at an elevation of 12500 feet.

10. *Juncus castaneus* Smith. Another high mountain form known in New Mexico so far only from Truchas Peak. Arctic-alpine Zone.

11. *Juncus longistylis* Torr. Fairly common at middle elevations of from 7000 to 8500 feet, in the mountains throughout the State; in the Transition Zone.

12. *Juncus bufonius* L. A small annual plant occurring beside mountain streams in sandy soil: never common or important; Transition or Upper Sonoran Zone.

13. *Juncus dudleyi* Wiegand. A common species in cool cienagas or bogs at elevations of 7000 to 9000 feet; Transition Zone.

14. *Juncus interior* Wiegand. Similar to and associated with the preceding; possibly not distinct.

15. *Juncus arizonicus* Wiegand. A common species in wet places at the lower levels especially in the southern part of the State, from 5000 feet up to 7500 feet; in the Upper Sonoran and Transition Zones.

2. JUNCOIDES Adans. WOOD RUSHES.

Flowers on slender pedicels in corymbiform panicles.

1. *J. parviflorum*.

Flowers in spike-like clusters.

Spikelets peduncled forming a corymb; flowers light yellow.

2. *J. intermedium*.

Spikelets sessile forming a compound spike; spike nodding; bractlets ciliate.

3. *J. spicatum*.

1. *Juncoides parviflorum* (Ehrh.) Coville. Occurs on the high peaks of the northern part of the State about timber line or above it; in the Arctic-alpine Zone.

2. *Juncoides intermedium* (Thuill.) Rydb. Known in New Mexico from a single specimen collected on the Upper Pecos; in the Transition Zone.

3. *Juncoides spicatum* (L.) Kuntze. At high altitudes in the mountains of the northern part of the State; Canadian and Hudsonian Zones.

ACKNOWLEDGEMENTS

In the preparation of this bulletin the authors have had the kindly and valuable personal assistance of Dr. A. S. Hitchcock, Dr. David Griffiths, Dr. F. V. Coville and Mrs. Agnes Chase on many occasions. Dr. Hitchcock in particular placed the grass collection of the National Herbarium and the library of that division at our disposal and gave us freely of his advice and experience. Dr. F. V. Coville kindly assisted us in the determination of the species of *Juncus*. To say that we appreciated the services rendered by these scientific workers and are grateful for their assistance expresses but mildly the obligations under which we feel ourselves placed.

The Life Zone Map is a copy of one prepared by Mr. Vernon Bailey in the Bureau of the Biological Survey, and we are permitted to publish it through the courtesy of Dr. H. W. Henshaw, Chief of that Bureau. We certainly are thankful for this privilege since it so materially improves and crystallizes the information contained in this bulletin.

We are also indebted to the Department of Agriculture for the excellent figures with which we are able to illustrate the bulletin.

In the preparation of the keys, the latest manuals and other publications relating to grasses have been freely used without citation; and we wish to give public expression here of our indebtedness to Rydberg's *Flora of Colorado*, Coulter and Nelson's *New Manual of the Rocky Mountain Region*, Small's *Flora of the Southeastern States*, and the various publications of the United States Department of Agriculture, especially the division of Agrostology bulletins as well as the contributions from the National Herbarium, all of which have been in continuous use.

The authors are indebted to the Arizona Experiment Station for the use of ten plates showing various grasses, credit being given under each plate.



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